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REVISED ATTACHMENT D

PROJECT MANUAL

FOR

SOLID WASTE / TE&O RENOVATION

4300 29TH STREET SOUTH, ARLINGTON, VIRGINIA

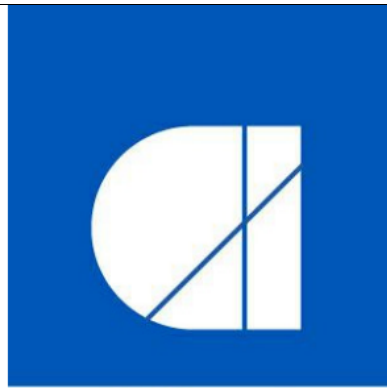
ARLINGTON COUNTY VIRGINIA



ARLINGTON
VIRGINIA

VOLUME 1 OF 2
DIVISIONS 01 THROUGH 12

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4300 29TH STREET SOUTH, ARLINGTON, VIRGINIA

ARLINGTON COUNTY VIRGINIA



ARLINGTON
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VOLUME 2 OF 2
DIVISIONS 21 THROUGH 33

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TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

01 02 00	GENERAL SITEWORK REQUIREMENTS
01 10 00	SUMMARY
01 25 00	SUBSTITUTION PROCEDURES
01 26 00	CONTRACT MODIFICATION PROCEDURES
01 29 00	PAYMENT PROCEDURES
01 30 00	ADMINISTRATIVE REQUIREMENTS
01 31 00	PROJECT MANAGEMENT AND COORDINATION
01 31 14	FACILITY SERVICES COORDINATION
01 32 00	CONSTRUCTION PROGRESS DOCUMENTATION
01 32 33	PHOTOGRAPHIC DOCUMENTATION
01 33 00	SUBMITTAL PROCEDURES
01 35 16	ALTERATION PROJECT PROCEDURES
01 40 00	QUALITY REQUIREMENTS
01 42 00	REFERENCES
01 50 00	TEMPORARY FACILITIES AND CONTROLS
01 51 00	TEMPORARY UTILITIES
01 52 13	FIELD OFFICES AND SHEDS
01 55 00	VEHICULAR ACCESS AND PARKING
01 56 39	TEMPORARY TREE AND PLANT PROTECTION
01 57 19	TEMPORARY ENVIRONMENTAL PROTECTION
01 58 13	TEMPORARY PROJECT SIGNAGE
01 60 00	PRODUCT REQUIREMENTS
01 61 16	VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS
01 61 16.01	ACCESSORY MATERIAL VOC CONTENT CERTIFICATION FORM
01 70 00	EXECUTION AND CLOSE OUT
01 73 00	EXECUTION
01 74 19	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
01 77 00	CLOSEOUT PROCEDURES
01 78 00	CLOSEOUT SUBMITTAL
01 78 23	OPERATION AND MAINTENANCE DATA
01 78 39	PROJECT RECORD DOCUMENTS
01 79 00	DEMONSTRATION AND TRAINING
01 83 16	EXTERIOR ENCLOSURE PERFORMANCE REQUIREMENTS
01 91 13	GENERAL COMMISSIONING REQUIREMENTS

DIVISION 02 - EXISTING CONDITIONS

02 41 13	SELECTIVE SITE DEMOLITION
02 41 19	SELECTIVE DEMOLITION

DIVISION 03 - CONCRETE

03 30 00	CAST-IN-PLACE CONCRETE
----------	------------------------

03 54 16 HYDRAULIC CEMENT UNDERLAYMENT

DIVISION 04 - MASONRY

04 20 00 UNIT MASONRY

DIVISION 05 - METALS

05 12 00 STRUCTURAL STEEL FRAMING
05 31 00 STEEL DECKING
05 40 00 COLD-FORMED METAL FRAMING
05 52 13 PIPE AND TUBE RAILINGS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 00 ROUGH CARPENTRY
06 20 00 FINISH CARPENTRY

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 11 13 BITUMINOUS DAMPPROOFING

07 14 00 FLUID-APPLIED WATERPROOFING
07 21 00 THERMAL INSULATION
07 27 10 FLUID-APPLIED MEMBRANE AIR BARRIER
07 54 16 ADHERED TPO SHEET ROOFING
07 62 00 SHEET METAL FLASHING AND TRIM
07 71 00 MANUFACTURED ROOF SPECIALTIES
07 71 23 MANUFACTURED GUTTERS AND DOWNSPOUTS
07 72 00 ROOF ACCESSORIES
07 84 00 FIRESTOPPING
07 84 46 FIRE RESISTIVE JOINT SYSTEMS
07 92 00 JOINT SEALANTS

DIVISION 08 - OPENINGS

08 11 13 HOLLOW METAL DOORS AND FRAMES
08 14 16 FLUSH WOOD DOORS
08 31 00 ACCESS DOORS AND FRAMES
08 62 70 TUBULAR SKYLIGHTS
08 71 00 DOOR HARDWARE
08 80 00 GLAZING
08 83 00 MIRRORS
08 91 00 LOUVERS

DIVISION 09 - FINISHES

09 21 16	GYPSUM BOARD ASSEMBLIES
09 22 16	NON-STRUCTURAL METAL FRAMING
09 30 00	TILING
09 51 00	ACOUSTICAL TILE CEILINGS
09 65 00	RESILIENT FLOORING
09 68 13	TILE CARPETING
09 91 23	INTERIOR PAINTING
09 96 00	HIGH-PERFORMANCE COATINGS

DIVISION 10 - SPECIALTIES

10 14 00	SIGNAGE
10 21 13.19	PLASTIC TOILET COMPARTMENTS
10 28 00	TOILET ACCESSORIES
10 44 00	FIRE PROTECTION SPECIALTIES
10 51 26	PLASTIC LOCKERS

DIVISION 11 - EQUIPMENT

11 24 23	FALL PROTECTION SYSTEM
11 30 13	APPLIANCES

DIVISION 12 - FURNISHINGS

12 35 50	INSTITUTIONAL CASEWORK
12 36 00	COUNTERTOPS
12 93 00	SITE FURNISHINGS

DIVISION 22 - PLUMBING

22 00 00	PLUMBING BASIC REQUIREMENTS
22 05 13	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
22 05 19	PLUMBING DEVICES
22 05 23	GENERAL-DUTY VALVES FOR PLUMBING PIPING
22 05 29	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
22 05 33	HEAT TRACING FOR PLUMBING PIPING
22 05 53	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
22 05 93	TESTING, ADJUSTING, AND BALANCING FOR PLUMBING
22 07 00	PLUMBING INSULATION

22 10 00 PLUMBING PIPING

22 30 00 PLUMBING EQUIPMENT

22 40 00 PLUMBING FIXTURES

DIVISION 23 - MECHANICAL

23 00 00 HEATING, VENTILATING AND AIR CONDITIONING BASIC REQUIREMENTS

23 05 29 HVAC PIPE HANGERS AND SUPPORTS

23 05 48 VIBRATION CONTROLS FOR HVAC EQUIPMENT

23 05 53 IDENTIFICATION FOR HVAC PIPING, DUCTWORK, AND EQUIPMENT

23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

23 07 00 HVAC INSULATION

23 21 13 HVAC PIPING

23 31 00 HVAC DUCTS AND CASINGS

23 33 00 AIR DUCT ACCESSORIES

23 37 00 AIR OUTLETS AND INLETS

23 81 26 SMALL SPLIT SYSTEM AND UNITARY HVAC EQUIPMENT

DIVISION 26 - ELECTRICAL

26 00 01 ELECTRICAL BASIC REQUIREMENTS

26 05 01 ELECTRICAL DEMOLITION

26 05 09 ELECTRICAL WIRING

26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

26 05 33 RACEWAYS

26 05 34 BOXES

26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS

26 05 73 ELECTRICAL DISTRIBUTION SYSTEM STUDIES

26 09 23 OCCUPANCY AND VACANCY SENSORS

26 24 16 PANELBOARDS

26 27 26 WIRING DEVICES

26 28 00 OVERCURRENT PROTECTIVE DEVICES

26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

26 29 13 ENCLOSED CONTROLLERS

26 51 00 LIGHTING

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 00 01 ELECTRONIC SAFETY BASIC REQUIREMENTS

28 31 00 FIRE DETECTION AND ALARM

DIVISION 31 - EARTHWORK

31 20 00 EARTHWORK
31 25 00 EROSION CONTROL

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 12 16 ASPHALT PAVEMENT
32 13 13 SITE CONCRETE
32 17 00 PAVEMENT MARKINGS, SIGNS AND SPECIALTIES
32 92 00 LAWNS AND GRASSES
32 31 13 CHAIN LINK FENCES AND GATES

DIVISION 33 - UTILITIES

33 10 00 EXTERIOR WATER SYSTEM

END OF TABLE OF CONTENTS

SECTION 010200 - GENERAL SITEWORK REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.
- B. Latest edition of the Arlington County Construction Standards and Specifications Manual and Construction Standards Detail.

1.02 SITEWORK LAYOUT

- A. Monuments and Benchmarks
 - 1. Maintain all monuments, property corners, bench marks and other reference points.
 - 2. If these are disturbed or destroyed during construction operations, have them replaced by a surveyor licensed in the Commonwealth of Virginia. This replacement shall be at no additional expense to the Contract.
- B. Laying out the Work.
 - 1. Locate all existing bench marks and other reference points.
 - 2. Protect these points throughout construction.
 - 3. Layout work utilizing these reference points.
- C. Record Drawings
 - 1. Maintain a record of the locations of all underground utilities and piping.
 - 2. Maintain a record of any variations of the work.
 - 3. Record drawings shall include verification that grades have been installed per plan.
 - 4. Record drawings shall include invert elevations of underground detention facilities, including but not limited to the invert elevation of any control orifice, inlets, outlets, and the elevation of the bottom and top of the structures.
 - 5. Record Drawings shall be certified by a Land Surveyor registered in the Commonwealth of Virginia.
 - 6. Submit these record drawings in hardcopy and Auto CADD format at Project Closeout.

1.03 EASEMENTS

- A. Verify the acquisition of all off-site easements and Rights-of-Way prior to the start of off-site construction. This may be done by contacting the Architect / Engineer.
- B. Restore all off-site easements to the condition existing prior to the start of work.

1.04 MAINTENANCE OF TRAFFIC

- A. Maintain vehicular and pedestrian traffic throughout the construction process. Comply with all applicable safety requirements in accordance with VDOT, State and Local requirements.

1.05 SUBMITTALS

- A. For those submittals, close-out documents and O&M manuals requiring review by the Architect's consultants, contractor shall be made via e-builder.

1.06 CORRELATION OF CONSTRUCTION DOCUMENTS

- A. Review construction documents thoroughly prior to the start of construction.
- B. Report any conflict or discrepancy discovered in the Construction Documents to the Architect / Engineer prior to the start of construction.
- C. Report any conflict or discrepancy discovered between the Construction Documents and state and local governmental regulations to the Architect / Engineer prior to the start of construction.

1.07 PROJECT CONDITIONS

- A. The conditions existing at the time of inspection for bidding purposes will be maintained by the Owner to the extent practical. Existing conditions of the site were surveyed by Timmons Group and are the anticipated site conditions expected at the time of contract execution. However, minor variations may occur due to natural occurrences prior to the start of clearing work.
- B. The location of existing underground utilities indicated is approximate only. Field locate all existing underground utilities in the area of work, regardless of whether or not they are indicated. Call "Miss Utility" prior to the start of demolition work for assistance in the location of existing underground utilities.
- C. Should charted, uncharted or incorrectly charted utilities be encountered during demolition, contact the Architect / Engineer immediately for instructions. Cooperate with Owner and utility companies to keep services and facilities in operation.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTIONS

3.01 PROJECT CLEAN UP

- A. Clean site as construction progresses. Do not allow trash or other waste materials to accumulate.
- B. Remove all perimeter trees and root matter along construction limits that fall during construction. Restore ground where root balls are removed to maintain existing grades and positive drainage.
- C. Prior to requesting the punch-list inspection, clean the site to the following requirements:
 - 1. Power wash all walks, curbs and pavements.
 - 2. The remainder of the site shall be broom clean.
 - 3. Remove all trash and debris from site, storm structures and limits of construction.

3.02 EXISTING FACILITIES

- A. Preserve existing signs, markers, guardrails and fences in their original condition unless written permission is obtained for their removal and replacement.
- B. Replace damaged items at no additional cost to the Contract.

END OF SECTION 010200

SUBMITTAL PROCEDURES

013300 - 2

SECTION 01 10 00 - SUMMARY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work by Owner.
5. Work under separate contracts.
6. Access to site.
7. Coordination with occupants.
8. Work restrictions.
9. Specification and Drawing conventions.
10. Miscellaneous provisions.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

C. Common Definitions Used in the Specification:

1. Owner - Arlington County and its various sub entities.
2. Architect - Designer of Record hired by the County as a consultant.
3. Engineer - Designer of Record hired by the county or by a consultant or contractor under contract with the County
4. Project Manager - Arlington Count Project Officer.
5. Construction Manager - Consultant hired by the County to assist the Project Officer.
6. Contractor - General Contractor hired by the County to construct the project or subcontractor under contract to the General Contractor.

1.3 PROJECT INFORMATION

- A. Project Identification: 4300 S 29th Street, Arlington VA.
- B. Owner: Arlington County Board
 1. Owner's Representative:
 - a. Facilities Management Bureau
- C. Architect: Architecture, Incorporated
 1. Architect's Representative:
- D. Architect's Consultants: Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
- E. Contractor: "To be determined" has been engaged as Contractor for this Project.
- F. Web-Based Project Software: Project software administered by Owner will be used for purposes of managing communication and documents during the construction stage. At the Owner's discretion and by direction and approval of the Project Officer the Architect or the

Contractor but, not both, may make Project Management Software available for use by the team at no extra cost to the Owner or other Team members.

1. See Section 01 31 00 "Project Management and Coordination." for requirements for establishing administering and using web-based Project software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The Solid Waste and TE&O Renovation Project consists of a partial renovation of the occupied building which includes an interior locker room refresh as well as the addition of a utility closet to the main building. The site is located at the Arlington County Trade Center and all other facilities will be active during construction.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 PROJECT TEAM BUILDING EXERCISE

A. Within 21 days after the Notice to Proceed, the Contractor shall sponsor a team building workshop, held onsite and chaired by an independent facilitator experienced in construction project team building. Participants shall include Contractor's key Project, Contractor's project executive, the Architect and County staff. The workshop shall be a minimum of four hours' duration.

1.6 CONSTRUCTION PERMITS

A. The County will obtain and pay fees for the Building Construction Permit and Certificate of Occupancy. The Contractor shall be solely responsible for thoroughly understanding, obtaining, and paying for all other permits requirement as it pertains to work under this Contract. All Permits obtained by The County are the responsibility of the Contractor to track and monitor for renewal. The Contractor will notify the County at least 30 days prior to the permit expiration date.

B. Permits required for the project may include some or all of the following, but are not limited to:

1. County Land Disturbing Activities (LDA) permit
2. County Public Right-Of-Way (PROW) permit
3. County Transportation Right-Of-Way(TROW) permit
4. VDOT Land Use Permit
5. VDOT Open Cut Permit

C. All fees for County DES permits will be waived by Arlington County, and fees for non-County permits will be paid by Arlington County.

D. The County LDA permit, VDOT Land Use and Open Cut permits will be obtained by the County prior to the start of Work. These permits shall be transferred to the Contractor as the named permittee and/or responsible party prior to the start of Work. The Contractor shall complete and sign both the VDOT LUP-E&S and LUP-WZTC forms and submit to the County Project Officer for submission to VDOT prior to the start of Work.

E. The Contractor is responsible for obtaining an Arlington County PROW and TROW permits for any work within the Arlington County Right-Of-Way. The Contractor is responsible for obtaining all other required permits not obtained by the County. The Contractor is responsible for investigating and satisfying all County and VDOT Permit requirements.

- F. The Contractor shall provide a Responsible Land Disturber (RLD) that meets all the required qualifications of the permits. The Contractor shall complete and sign the RLD certificate and submit to the County Project Officer prior to the start of Work
- G. Any activities requiring welding or soldering shall require a Permit from Arlington County. The permit shall include time frame for welding or soldering, certification of welder and method of odor and/or smoke mitigation. The permit shall be submitted for work no greater than 5 days in duration and shall be submitted a 3 day in advance of the associated work. The contractor shall receive written authorization for the permit from Arlington County prior to initiating work requiring the permit.
- H. The Contractor shall be responsible for scheduling and coordinating inspections and receipts of local or state permits/approvals/certifications for any tanks, piping and associated appurtenances, which are constructed, installed tested or removed as part of this contract.

1.7 INSPECTIONS

- A. It is the contractor's responsibility to schedule all required inspections with either of the appropriate parties (ISD, DES, Inspection Agency, VDOT, etc...).
- B. The contractor is required to fully understand the County inspection process and is responsible for researching and obtaining all required permits and or non-permit reviews as identified by Arlington County Government. See www.arlingtonva.us for applicable requirements.

1.8 PHASED CONSTRUCTION

- A. The phasing of the project will be the responsibility of the General Contractor, with the means and methods of construction determined by the General Contractor, while ensuring that the warranties for the systems are not affected by the contractor selected means and methods.
- B. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all phases of the Work.

1.9 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
 - 1. Not applicable
- C. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.
 - 1. Security Contractor - Protection One/ADT will install all card readers or cameras as shown on the drawings.
 - 2. Furniture Moving Contractor - TBD - Will move in owner supplied furniture prior to certificate of occupancy.
- D. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory Work under this Contract.
 - 1. Furniture Moving Contractor - TBD - Will continue to move in owner supplied furniture not required to be installed prior to certificate of occupancy.

1.10 OWNER-FURNISHED PRODUCTS

A. Owner-Furnished Products:

1. See contract documents for Owner-Furnished Items

1.11 ACCESS TO SITE

- A. The Contractor's use of the premises is limited by the Owner's right to perform construction operations with its own forces or to employ separate contractors on portions of the project.
- B. The Contractor's use of the premises for construction activities with respect to the production of noise or odors which impact the occupied areas of the building during occupied building hours shall be limited. Activities which include, but are not limited to welding, soldering, demolition, saw cutting and rigging shall, in the sole opinion of Arlington County, not adversely impact or affect the laboratory operations. Remedial measures to eliminate the source of the impacts shall be undertaken by the Contractor at the Contractor's expense. If impacts are not addressed to the satisfaction of Arlington County, the Contractor shall modify the work schedule and perform the activities which impact the occupied areas of the building during non-occupied building timeframes.
- C. Staging: The staging area will be confined to the staging area defined and established with the County. No material will be staged on the sidewalks, other areas around the other buildings. The contractor must visit the site prior to bid to familiarize himself with the existing conditions and staging area. The contractor is responsible for coordinating, furnishing and implementing any Maintenance of Traffic (MOT) required for staging operations.
- D. Photography: Contractor shall maintain a photographic record of the project both with monthly overall progress photos and repair specific photos. This is to include photos taken pre-construction, pre-repair (post cleaning and prep), and post repair. Submit repair photos with monthly progress photos along with monthly request for payment.
- E. The contractor shall be aware that limited ceiling heights exist throughout the building.
- F. The Contractor shall assume full responsibility for materials and equipment stored on-site.
- G. The Contractor shall limit the use of the premises to the work indicated, so as to allow for the County occupancy and operation at all times.
 1. Confine equipment, the storage of materials and equipment, and operations of workmen to within the defined project site or as identified on the drawings.
 2. Storage of equipment (either demolished or new units to be installed) shall not occur within occupied building space and shall be constrained to areas designated by the owner.
 3. Keep the existing driveways, loading docks and entrances serving the premises clear and available to the County and his/her employees at all times. Do not use these areas for parking or storage of materials.
 4. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and locations of storage sheds to the areas designated by the County. If additional storage is necessary, obtain and pay for such storage off site.
 5. No use of county trash dumpsters shall be permitted.
 6. Weatherproofing of the exterior building shell shall be maintained by the Contractor during all construction activities.
- H. Access to the facility and emergency egress doors shall be accessible to the building occupants at all times.
- I. Limited construction/demolition debris shall be permitted for transportation through occupied spaces within the building.

1.12 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, 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 approval of authorities having jurisdiction.
 - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
- B. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, except for 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.
- C. 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.

1.13 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise coordinated. It is understood and expected to have early morning, night and weekend work to complete this work.
 - 1. Weekend Hours: Permitted between 7:00 am and 5:00 pm on weekends and County holidays, when approved in writing 24 hours prior to any activity start by the County Project Officer.
 - 2. Early Morning Hours: Permitted with approval of the County Project Officer.
 - 3. Hours for Utility Shutdowns: After normal business hours.
 - 4. Hours for Core Drilling: After normal business hours.

- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify County Project Officer not less than two days in advance of proposed utility interruptions.
 - 2. Obtain County Project Officer's written permission before proceeding with utility interruptions.
 - D. Noise, Vibration, and Odors: Coordinate operations that may result in medium to high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
 - 3. Provide coordination schedule that indicates proposed dates for the activities that fall under the above criteria.
 - E. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
 - F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
 - G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.
 - H. Construction/ Contractor/ Subcontractor Parking
 - 1. There will be designated on-site parking spaces allowed for vehicles belonging to the Contractor and their sub-Contractors.
 - 2. No on-site parking will be allowed. All parking for construction will be provided by the contractor at its expense offsite.
 - I. Delivery of Building Material and Removal of Trash
 - 1. The Contractor shall not obstruct the main entry to the site and roadways and/or roadways inside the site at any time for the delivery of building materials and the removal of all refuse, rubbish, scrap materials and debris. The Contractor shall use designated areas for loading, delivery and removal of debris/trash. Coordinate any materials or containers leaving the site with security
 - J. BACNET
 - 1. All equipment shall be compatible and able to communicate with Arlington Counties BAS (Bacnet). Any questions regarding Bacnet should be asked during the pre-bid RFI period.
- 1.14 SPECIFICATION AND DRAWING CONVENTIONS
- A. It is the contractor's responsibility to review and understand drawings and specifications. Any discrepancies or issues shall be addressed via an RFI prior to bid day. Any discrepancies brought up after bid day are subject to non-payment by the County and the greater condition shall be assumed as included in the contract sum.
 - B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

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

1.15 CONSTRUCTION STANDARDS

- A. All work shall conform to project plans, specifications and supplementary specifications along with the current edition of following County and State Construction Standards, as applicable:
 1. The Arlington County Department of Environmental Services (DES) Construction Standards and Specifications, a copy of which may be downloaded at no charge from the internet at:
 - a. <http://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/21/2013/12/Construction-Specifications-9-30-13.pdf>
 2. The Arlington County Department of Environmental Services (DES) Traffic Signal & Streetlight Specifications, a copy of which may be downloaded at no charge from the internet at:
 - a. <http://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/21/2013/12/Traffic-Signal-and-Street-Light-Specifications.pdf>
 3. The Arlington County Department of Environmental Services (DES) Streetlight Specifications, a copy of which may be downloaded at no charge from the internet at: <https://transportation.arlingtonva.us/streets/street-lights/lighting-standards-specifications-updates/>
 4. The Arlington County Department of Environmental Services (DES) Pavement Marking Specifications, a copy of which may be downloaded at no charge from the internet at:
 - a. <http://transportation.arlingtonva.us/streets/traffic-signals/>
 5. The Arlington County Department of Parks and Recreation (DPR) Specifications, a copy of which may be downloaded at no charge from the internet at:
 - a. <http://parks.arlingtonva.us/design-standards/>
 6. The Arlington County Department of Environmental Services (DES) Dichlorination and Disposal Procedures, a copy of which may be downloaded at no charge from the internet at:
 - a. <http://topics.arlingtonva.us/building/discharging-chlorinated-water/>
 7. The Virginia Department of Transportation (VDOT) Road and Bridge Standards and Specifications, a copy of which may be downloaded at no charge from the internet at: http://www.virginiadot.org/business/locdes/Standards_TOC.asp
 - a. and <http://www.virginiadot.org/business/const/spec-default.asp>
 8. The Virginia Department of Transportation (VDOT) - • The Virginia Work Area Protection Manual (WAPM) found on the internet at:
 - a. <http://www.virginiadot.org/business/trafficeng-WZS.asp>

9. Manual on Uniform Traffic Control Devices(MUTCD), a copy of which may be downloaded at no charge from the internet at:
http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm
10. The Virginia Department of Transportation (VDOT) - Supplement to the MUTCD found on the internet at:
 - a. http://www.virginiadot.org/business/virginia_mutcd_supplement.asp

P2 PRODUCTS (Not Used)

P3 EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and in accordance with procedures required for Change Order proposals
 - 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 ICC-ES.
 - 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 of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

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 and revisions to Contract Documents are not required.
- b. Requested substitution provides sustainable design characteristics that specified product provided for compliance with LEED requirements. The stated County Goal is LEED Silver for all projects over \$!,000,000.00.
- c. Substitution request is fully documented and properly submitted.
- d. Requested substitution will not adversely affect Contractor's construction schedule.
- e. Requested substitution has received necessary approvals of authorities having jurisdiction.
- f. Requested substitution is compatible with other portions of the Work.
- g. Requested substitution has been coordinated with other portions of the Work.
- h. Requested substitution provides specified warranty.
- i. 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.
- j. The request is timely, fully documented and properly submitted. The specified product or method of construction can be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
- k. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the A/E for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

B. Substitutions for Convenience: Not allowed.

P2 PRODUCTS (Not Used)

P3 EXECUTION (Not Used)

END OF SECTION 01 25 00

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SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 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 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue through the Owner 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: The Owner 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 the Owner are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 14 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to the Owner.
 - 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 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

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

P2 PRODUCTS (Not Used)

P3 EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
 - 3. Section 01 81 13.14 "Sustainable Design Requirements - LEED v4 BD+C" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.
 - 4. Section 01 81 13.17 "Sustainable Design Requirements - LEED v4 ID+C" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.

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. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
 - 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 the Project Officer or his representative at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
 - 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract, as described in Section 01 10 00 "Summary."

- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one-line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange schedule of values consistent with format of AIA Document G703.
 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. 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. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
 8. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
 9. 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 the Project Officer or designated representative and paid for by Owner.

- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. The Project Officer or designated 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 three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Sustainable design action plans, including preliminary project materials cost data.
 6. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706.
 5. AIA Document G706A.
 6. Evidence that claims have been settled.
 7. 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.
 8. Final liquidated damages settlement statement.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electronic document submittal service.
- B. Project coordination.
- C. Requests for interpretation (RFI).
- D. Subcontract list.
- E. Staff names and assignments.
- F. Preconstruction meeting.
- G. Progress meetings.
- H. Contractor's daily reports.
- I. Progress photographs.
- J. Submittals for review, information, and project closeout.
- K. Number of copies of submittals.
- L. Submittal procedures.
- M. Contractor's use of Architect's CAD files.
- N. Delegated design.
- O. Contractor's review.
- P. Architect's action.

1.2 PROJECT COORDINATOR

- A. Project Coordinator: General Contractor.
- B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for vehicle and truck access, traffic, and parking facilities.
- C. During construction, coordinate use of site and facilities through the Project Coordinator.
- D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 01 50 00 - Temporary Facilities and Controls.
- F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- G. Make the following types of submittals to Architect through the Project Coordinator:
 - 1. Requests for Interpretation.
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Closeout submittals.

1.3 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
 3. Frivolous RFIs: The Contractor will compensate the Owner for the Architect's time and expenses to process RFIs resulting from the Contractor's lack of studying and comparing the Contract Documents, coordinating their own Work, or repeating previous RFIs.
 4. Submit RFIs through the Web-based Project Management Software, in PDF format.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Name of Architect.
 5. RFI number, numbered sequentially.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
 - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Format of RFIs:
1. Software-Generated RFIs:
 - a. Preferred format.
 - b. Software-generated form with substantially the same content as indicated above.
 - c. Photographs shall be electronic files in JPG format.
 - d. Attachments shall be electronic files in Adobe Acrobat PDF format.
 2. Hard-Copy RFIs:
 - a. Permitted under conditions where electronic RFI is not feasible.
 - b. Identify each page of attachments with the RFI number and sequential page number.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond through the Web-based Project Management Software. Allow ten working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs may be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.

- c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 3. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, submit Change Order Request within 10 days of receipt of the RFI response as provided by General Conditions of the Contract. Contractor waives any right to make a claim by not initiating action within this 10-day duration of time.
- E. On receipt of Architect's action, immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepared and maintained by the Architect within the Web-based Project Management Software; Contractor to maintain a separate RFI log with subcontractors.

1.4 SUBCONTRACT LIST

- A. Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:
1. Name, address, and telephone number of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
 3. Drawing number and detail references, as appropriate, covered by subcontract.
 4. Number of Copies: Submit four copies of subcontractor list, unless otherwise indicated. Architect will return two copies.
 - a. Mark up and retain one returned copy as a Project Record Document.

1.5 STAFF NAMES AND ASSIGNMENTS

- A. Submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site, prior to or coinciding with initial Application for Payment.
- B. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers.
- C. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
- D. Post copies of list in Project meeting room, in temporary field office, and by each temporary phone.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format, and transmitted via an Internet-based submittal service that receives, logs and

stores documents, provides electronic stamping and signatures, and notifies addressees via email.

1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 2. Contractor and Architect are required to use this service.
 3. It is Contractor's responsibility to submit documents in allowable format to the service.
 4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.
- C. Submittal Service - The selected service is:
1. Newforma ConstructEx: www.newformaprojectcloud.com/#sle.
 - a. Newforma Contact: Dan Taschereau; Tel. 603-440-3908; dtaschereau@newforma.com.
- D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
- E. Project Closeout: Architect will determine when to terminate the service for the project, Contractor shall obtain an archive copy of the project files from the service for the Architect and Owner.

3.2 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
1. Owner.
 2. Architect.
 3. Contractor.
- C. Agenda:
1. Execution of Owner-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Designation of personnel representing the parties to Contract Owner and .
 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.

7. Scheduling.

- D. Contractor to record minutes and post to web based project management software within two days after meeting.

3.3 PROGRESS MEETINGS

- A. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

- B. Attendance Required: Contractor's project manager and job superintendent, major Subcontractors and suppliers, Owner, Architect, as appropriate to agenda topics for each meeting.

- C. Agenda:

1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. Other business relating to work.

- D. Architect to record minutes and post to web based project management software within five days after meeting.

3.4 DAILY CONSTRUCTION REPORTS

- A. Submit electronically via Electronic Document Submittal Service at a weekly interval.

- B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:

1. Date.
2. High and low temperatures, and general weather conditions.
3. List of subcontractors at Project site.
4. Approximate count of personnel at Project site for each trade.
5. List of construction activities performed (fore each trade).
6. Major equipment at Project site.
7. Safety, environmental, or industrial relations incidents.
8. Meetings and significant decisions.
9. Accidents and unusual events (submit a separate special report).
10. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
14. Change Orders received and implemented.
15. Testing and/or inspections performed.
16. Services connected or disconnected.

17. Equipment or systems tests and start-ups.
18. Partial completions, occupancies.
19. Signature of Contractor's authorized representative.

3.5 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Photography Type: Digital; electronic files.
- C. Provide photographs of site and construction throughout progress of Work produced by a photographer, acceptable to Architect.
- D. In addition to periodic, recurring views, take photographs of each of the following events:
 1. Excavations in progress.
 2. Foundations in progress and upon completion.
 3. Structural framing in progress and upon completion.
 4. Enclosure of building, upon completion.
 5. Final completion, minimum of ten (10) photos.
- E. Views:
 1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 2. Consult with Architect for instructions on views required.
 3. Provide factual presentation.
 4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
- F. Digital Photographs: 24 bit color, minimum resolution of 1600 by 1200 ("2 megapixel"), in JPG format; provide files unaltered by photo editing software.
 1. Delivery Medium: Web-based Project Management Software.
 2. File Naming: Include project identification, date and time of view, and view identification.
 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
 4. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.
- G. Additional Photographic Requirements: Refer to Section 01 57 21 for photographic documentation requirements for Indoor Air Quality Controls.

3.6 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Package these submittals by specification section, except closeout submittals or Work performed by separate trades, in a single delivery to the Architect; failure of the Contractor to package these submittals in a single delivery may cause the Architect to withhold action on submittal until associated submittals required by the particular specification section are received.
- C. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in the contract documents.

- D. Product data and shop drawings to be submitted and managed through the Web-based Project Management Software.
- E. Samples will be reviewed for aesthetic, color, or finish selection.
- F. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - CLOSEOUT SUBMITTALS.

3.7 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Daily construction reports.
 - 8. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.
- C. Informational submittals to be submitted and managed through the Web-based Project Management Software.

3.8 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.9 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Documents for Project Closeout: Make one reproduction of submittal originally reviewed. Submit one extra of submittals for information.
- C. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.10 SUBMITTAL PROCEDURES

- A. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

- B. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 21 days for initial review of each submittal; duration of time is defined by date received in Architect's office until the day sent from the Architect's office. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 21 days for review of each resubmittal; duration of time is defined by date received in Architect's office until the day sent from the Architect's office.
 4. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal; duration of time is defined by date received in consultant's office until the day sent to the Contractor. Submittals required within the following divisions to be sent directly to the Architect's consultants:
 - a. All required submittals indicated in Division 3 section.
 - b. The following required submittals indicated in Division 4:
 - 1) Product data, shop drawings, material certificates, mix designs, and cold-weather procedures.
 - c. All required submittals indicated in the following Division 5 Sections:
 - 1) Structural Steel
 - 2) Steel Joists
 - 3) Steel Decking
 - 4) Cold-Formed Metal Framing
 - 5) Metal Stairs
 - 6) Railings and Handrails
 - 7) Metal Fabrications
 - d. All required submittals indicated in the following Division 8 Section:
 - 1) Door Hardware
 - 2) Curtainwall
 - e. All required submittals for Food Service Equipment.
 - f. All required submittals indicated in Mechanical Divisions 21 through 23 sections.
 - g. All required submittals indicated in Division 26 sections.
 - h. All required submittals indicated in Divisions 31 through 33 sections.
 5. Color Selection: Architect will select colors within 60 days (to allow time for presentation to Owner and for Owner comments) after all color samples have been submitted including, but not limited to items listed below. The submittal data shall be complete, including shop drawings, product data, and color samples, and all required submittals and materials shall be in compliance with the specifications and be subsequently approved by the Architect. Color samples shall be actual samples of the material and not photographs. If there is a variation in color, shade, texture, or pattern, submit multiple samples to show full range of variation.
 - a. Interior Items (including but not limited to):

- 1) Plastic laminate, solid surface and millwork.
 - 2) Wood door veneer.
 - 3) Ceramic and porcelain tile.
 - 4) Resilient floor tile.
 - 5) Resilient wall base and accessories.
 - 6) Carpet tile.
 - 7) Acoustical wall and ceiling panels.
 - 8) Paint.
 - 9) High-performance coatings.
 - 10) Toilet compartments.
 - 11) Signs and cast letters.
 - 12) Casework veneer.
- b. Prefinished Exterior Items (including but not limited to):
- 1) Brick.
 - 2) Metal roofing.
 - 3) Metal wall panels.
 - 4) Phenolic wall siding.
 - 5) Copings, perimeter edge systems.
 - 6) Site furnishings and equipment.
- C. Submittal Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06 10 00.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06 10 00.01.A).
 - 2) Number and title of appropriate Specification Section.
 - 3) Drawing number and detail references, as appropriate.
 - 4) Location(s) where product is to be installed, as appropriate.
 - 5) Other necessary identification.
- D. Deviations: Encircle or otherwise specifically identify deviations from the Contract Documents on submittals.
- E. Resubmittals:
1. Resubmit submittals until they are marked "No Exception Taken" or "Note Markings".

2. Resubmission of items rejected or marked "Revise and Resubmit" will be reviewed one time by the Architect at no cost to the Contractor. Should the re-submittal be rejected or marked "Revise and Resubmit", the Contractor will reimburse the Owner by credit Change Order for all costs to the Owner for additional time spent by the Architect and the Architect's consultants to review the second (and subsequent) resubmission.
 - F. 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.
 - G. Use for Construction: Use only final submittals with mark indicating "No Exceptions Taken" or "Note Markings" taken by Architect.
- 3.11 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES
- A. At Contractor's written request, copies of Architect's CAD Drawing files will be provided to Contractor for Contractor's use in connection with Project; Contractor must sign and return the release form at the end of this Section.
 - B. Allow one week for processing, shipping and handling after Architect receives the signed form.
 - C. Only the files indicated on Agreement included at the end of this Section shall be made available for use as backgrounds for preparation of shop drawings and coordination drawings. No other CAD Drawing files, for this Project, will be made available.
- 3.12 DELEGATED DESIGN
- 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 Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional licensed in the Commonwealth of Virginia, 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.
- 3.13 CONTRACTOR'S REVIEW
- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
 - B. 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 through the Web-based Project Management Software.
 - C. Verify:
 1. Field Measurements.
 2. Field Construction Criteria.
 3. Catalog Numbers and Similar Data.
 4. Quantities.

- D. Contractor's responsibility regarding errors and omissions in submittals is not relieved by Architect's review of submittals.
- E. Contractor's responsibility regarding deviations in submittals from requirements of Contract Documents is not relieved by Architect's review of submittals, unless Architect gives written acceptance of specific deviations as approved by Owner.
- F. When work is directly related and involves more than one trade, coordinate submittal with other trades and submit under one cover.
- G. After a submittal has been submitted for review, no changes may be made to that Submittal other than changes resulting from review notes made by the Architect unless such changes are clearly identified and circled before being resubmitted. Any failure to comply with this requirement shall nullify and invalidate the Architect's review.
- H. Approval Stamp: Stamp each submittal. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents as indicated below:

THIS IS TO CERTIFY THAT THE SPECIFICATION REQUIREMENTS HAVE BEEN MET AND ALL DIMENSIONS, CONDITIONS, AND QUANTITIES ARE VERIFIED AS SHOWN AND/OR CORRECTED ON THESE DRAWINGS.

SIGNED _____

3.14 ARCHITECT'S/ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it; except where indicated otherwise. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. NO EXCEPTION TAKEN: The Work covered by the submittal is accepted as specified and the Work may proceed provided it complies with requirements of the Contract Documents.
 - 2. NOTE MARKINGS: The Work covered by the submittal is accepted as noted and the Work may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents.
 - 3. REVISE AND RESUBMIT: Do not proceed with the Work covered by the submittal. Revise or prepare a new submittal according to the notations and requirements of the Contract Documents, and resubmit without delay. Unmarked items may be fabricated if indicated.
 - 4. REJECTED: Architect will list reasons for rejection on the submittal or in the transmittal letter accompanying the submittal. Do not proceed with the Work covered by the submittal. Prepare new submittal according to the notations and requirements of the Contract Documents, and resubmit without delay.
 - 5. ACTION NOT REQUIRED: Either the submittal was not requested or the submittal was for information only or for record purposes.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION

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SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Related Requirements:
 - 1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.
 - 4. Section 01 91 13 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Construction Manager, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each 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; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in each built facility. 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.
 - 4. The General Contractor shall cooperate with and coordinate work required to be performed by the Owner's independent subcontractors.
- B. 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 by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.

- f. Indicate required installation sequences.
 - g. Indicate dimensions shown on 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. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling, raised access floor, and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Submittal Format: Submit or post coordination drawing files using PDF format.
3. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
4. Architect may furnish Contractor one limited set of digital data files of Drawings for use in preparing coordination digital data files at the direction of the Owner.
 - 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 2017.
 - 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. The Project Officer will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716 or 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 Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect 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 submitted at each coordination bi-weekly coordination meeting. Use software log that is part of web-based Project software log with not less than the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- 1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES
- A. Use of Architect's Digital Data Files: Digital data files of Architect's limited 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 2017.
 4. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement.

- 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 AIA Document C106.
5. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Reflected ceiling plans.
- B. Web-Based Project Software: The Project and all participants will use the [Owner's] [Architect's][Contractor's] web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.
- C. Web-Based Project Software: The Project and all participants will use the Architect's web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.
- D. Web-Based Project Software: The Project and all participants will use the Contractor's web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.
 1. Web-based Project software site includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
 2. Provide up to 14 web-based Project software user licenses for use of Owner, Owner's Commissioning Authority, Construction Manager, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for web-based Project software users.
 3. 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.

4. Provide one of the following web-based Project software packages under their current published licensing agreements:
 - a. Corecon Technologies, Inc.
 - b. Meridian Systems; Prolog.
 - c. Newforma, Inc.
 - d. Procore Technologies, Inc.
 - e. Viewpoint, Inc.; Viewpoint for Project Collaboration.
- E. 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: 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 10 working 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 everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.

- m. Submittal procedures.
 - n. Sustainable design requirements.
 - o. Preparation of Record Documents.
 - p. Use of the premises and existing building.
 - q. Work restrictions.
 - r. Working hours.
 - s. Owner's occupancy requirements.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.
 - w. Construction waste management and recycling.
 - x. Parking availability.
 - y. Office, work, and storage areas.
 - z. Equipment deliveries and priorities.
 - aa. First aid.
 - bb. Security.
 - cc. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Sustainable Design Requirements Coordination Conference: Owner will schedule and conduct a sustainable design coordination conference before starting construction, at a time convenient to Owner Architect, and Contractor.
- 1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent and sustainable design coordinator; 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 meeting sustainable design requirements, including the following:
 - a. Sustainable design Project checklist.
 - b. General requirements for sustainable design-related procurement and documentation.
 - c. Project closeout requirements and sustainable design certification procedures.
 - d. Role of sustainable design coordinator.
 - e. Construction waste management.
 - f. Construction operations and sustainable design requirements and restrictions.
 - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- D. 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, 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.
- E. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, 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.
- F. Progress Meetings: Conduct progress meetings at biweekly intervals. Progress meeting frequency can be adjusted with the Project Officers approval.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority 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) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.

- 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
4. Minutes: The General Contractor shall be responsible for conducting the meeting, recording and distributing 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

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SECTION 01 31 14 - FACILITY SERVICES COORDINATION**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Coordination documents.

1.2 SUBMITTALS

- A. Submit coordination drawings and schedules prior to submitting shop drawings, product data, and samples.
- B. Areas of Work requiring Coordination Drawings include all areas and rooms in this building. Complete the requirements for Coordination Drawings within 75 days of starting construction operations. Prepare Coordination Drawings since limited space availability necessitates maximum utilization of space for efficient installation of different components.
 - 1. Content: Project-specific information, drawn accurately to scale.
 - 2. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. The Construction Documents in their original, copies or electronic file form are the Architect's instrument of service and are protected under copyright laws.
 - 3. Include the following information, as applicable:
 - a. Follow routing shown on Contract Drawings for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.
 - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - c. Indicate required installation sequences.
 - d. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 - 4. Number of Copies: Submit digitally via the web-based project management software system.
 - a. Submit five copies where Coordination Drawings are required for operation and maintenance manuals. Architect will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing.
 - 5. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.
 - 6. Each trade shall sign and date the Coordination Drawings after the addition of their information.
 - 7. Do not begin fabrication until receipt of completed Coordination Drawings are acknowledged by the each contractor in writing to the Architect.
 - 8. No progress payments will be made for any work affected by coordination drawings until coordination drawings governing that work have been accepted.
 - 9. Any work installed prior to approval of coordination drawings shall be modified or replaced, as necessary, to conform to subsequently-approved construction drawings, at no additional cost to Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 COORDINATION REQUIRED

- A. Coordinate the work listed below:
 - 1. Fire Suppression: Division 21.
 - 2. Plumbing: Division 22.
 - 3. Heating, Ventilating, and Air Conditioning: Division 23.
 - 4. Integrated Automation: Division 25.
 - 5. Electrical: Division 26.
 - 6. Communications: Division 27.
 - 7. Electronic Safety and Security: Division 28.
 - 8. Site Utilities: Division 33.
 - 9. Commissioning requirements throughout the Project Manual.
- B. Coordinate progress schedules, including dates for submittals and for delivery of products.
- C. Conduct meetings among subcontractors and others concerned, to establish and maintain coordination and schedules, and to resolve coordination matters in dispute.
- D. Participate in progress meetings. Report on progress of work to be adjusted under coordination requirements, and any required changes in schedules. Transmit minutes of meetings and reports to concerned parties.
- E. 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.
- F. 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.
- G. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
- H. Make adequate provisions to accommodate items scheduled for later installation.

3.2 COORDINATION DOCUMENTS

- A. Prepare coordination drawings to organize installation of products for efficient use of available space, for proper sequence of installation, and to identify potential conflicts.
 - 1. Priority of Construction Space:
 - a. Coordinate installation of different components to ensure performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
 - b. Following is the Order of Priority of construction space:
 - 1) First: Ductwork.
 - 2) Second: Fire protection piping.
 - 3) Third: Other piping.
 - 4) Fourth: Conduit.

- B. Prepare a master schedule identifying responsibilities for activities that directly relate to this work, including submittals and temporary utilities; organize by specification section.
- C. Identify electrical power characteristics and control wiring required for each item of equipment.
- D. Maintain maximum headroom at all locations without finished ceilings.
- E. Maintain finished ceiling heights as indicated.
- F. Coordinate installations with other trades to prevent conflict with Work of other trades and cooperate in making reasonable modifications in layout as needed.
- G. Where conflicts occur with placement of mechanical and electrical materials as they relate to placement of other building materials, the Architect shall be consulted for assistance in coordination of the available space to accommodate all trades.
- H. Maintain documents for the duration of the work, recording changes due to site instructions, modifications or adjustments.
- I. Any construction delays required to accomplish coordination, approval of submittals or re-submittals, or consequent to coordination work, shall be incurred at no additional cost to Owner; such delays may include, but not be limited to , the following:
 - 1. Time taken for preparation and submission of acceptable coordination drawings, including a reasonable period for Architect's review and approval.
 - 2. Time taken for preparation and approval of acceptable mock-ups.
 - 3. Time taken for modifications and replacements of non-conforming work.

3.3 COORDINATION OF SUBMITTALS

- A. Review shop drawings, product data, and samples for compliance with Contract Documents and for coordination with related work. Transmit copies of reviewed documents to Architect.
- B. Check field dimensions and clearances and relationship to available space and anchors.
- C. Check compatibility with equipment and work of other sections, electrical characteristics, and operational control requirements.
- D. Check motor voltages and control characteristics.
- E. Coordinate controls, interlocks, wiring of switches, and relays.
- F. Coordinate wiring and control diagrams.
- G. When changes in the work are made, review their effect on other work.
- H. Verify information and coordinate maintenance of record documents.

3.4 COORDINATION OF SUBSTITUTIONS AND MODIFICATIONS

- A. Review proposals and requests for substitution prior to submission to Architect.
- B. Verify compliance with Contract Documents and for compatibility with work of other sections.

3.5 OBSERVATION OF WORK

- A. Observe work for compliance with Contract Documents.
- B. Maintain a list of observed deficiencies and defects; promptly submit.

3.6 EQUIPMENT START-UP

- A. Verify utilities, connections, and controls are complete and equipment is in operable condition as required by Section 01 70 00.
- B. Observe start-up and adjustments, test run, record time and date of start-up, and results.
- C. Observe equipment demonstrations made to Owner; record times and additional information required for operation and maintenance manuals.

3.7 INSPECTION AND ACCEPTANCE OF EQUIPMENT

- A. Prior to inspection, verify that equipment is tested, operational, clean, and ready for operation.
- B. Assist Architect with review. Prepare list of items to be completed and corrected.

END OF SECTION

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION**PART 1 GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. 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.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time belongs to Owner.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for 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, where indicated.

2. PDF file.
 3. Two paper copies, of sufficient size to display entire period or schedule, as required.
 - B. Startup construction schedule.
 1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
 - C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
 - D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
 - E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 3. Total Float Report: List of activities sorted in ascending order of total float.
 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
 - F. Construction Schedule Updating Reports: Submit with Applications for Payment.
 - G. Daily Construction Reports: Submit at monthly intervals.
 - H. Material Location Reports: Submit at monthly intervals.
 - I. Site Condition Reports: Submit at time of discovery of differing conditions.
 - J. Unusual Event Reports: Submit at time of unusual event.
 - K. Qualification Data: For scheduling consultant.
- 1.5 QUALITY ASSURANCE
- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
 - B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 1. Review software limitations and content and format for reports.
 2. Verify availability of qualified personnel needed to develop and update schedule.
 3. Discuss constraints, including phasing work stages area separations interim milestones and partial Owner occupancy.
 4. Review delivery dates for Owner-furnished products.
 5. Review schedule for work of Owner's separate contracts.
 6. Review submittal requirements and procedures.
 7. Review time required for review of submittals and resubmittals.

8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

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

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 1. Use Software package acceptable to the Owner and Architect for current Windows operating system.
- B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
 1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- C. Time Frame: Extend schedule from date established for the Notice of Award 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.
- D. 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 Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. .
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.

7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- E. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
 7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.

- e. Completion of electrical installation.
 - f. Substantial Completion.
- F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion, and the following interim milestones:
- 1. Temporary enclosure and space conditioning.
- G. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
- 1. See Section 01 29 00 "Payment Procedures" for cost reporting and payment procedures.
- H. 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.
- I. 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.
- J. 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.
- K. 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.
- 1.8 STARTUP CONSTRUCTION SCHEDULE
- A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice of Award.
- 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.

1.9 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 the Notice of Award.
 - 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.

1.10 CPM SCHEDULE REQUIREMENTS

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

1. Activities occurring following final completion.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of percent of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.

2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

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

- 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

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SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.
 - 4. Construction webcam.
- B. Related Requirements:
 - 1. Section 01 77 00 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
 - 2. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 3. Section 02 41 19 "Selective Demolition" for photographic documentation before selective demolition operations commence.
 - 4. Section 31 10 00 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Submit photos on thumb-drive or by uploading to web-based project 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 and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.4 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.
- B. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with record of providing satisfactory services similar to those required for Project.

1.5 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, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time and GPS location data from camera.
- D. File Names: Name media files with date and sequential numbering suffix.

1.6 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by the Owner.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take 20 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.
- D. Periodic Construction Photographs: Take 10 photographs monthly coinciding 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.
- E. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Owner will inform photographer of desired vantage points.
- F. Additional Photographs: Owner may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.
 - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

1.7 CONSTRUCTION WEBCAM

- A. Webcam: Provide two fixed-location camera(s) with weatherproof housing, mounted to provide unobstructed view of construction site from location approved by Architect, with the following characteristics:
 - 1. Remotely controllable view with mouse-click user navigation for horizontal pan, vertical tilt, and optical zoom of 500 percent minimum.
 - 2. Capable of producing minimum 12 megapixel images.
 - 3. Provide power supply, active high-speed data connection to service provider's network, and static public IP address for each camera.
- B. Live Streaming Images: Provide web-accessible image of current site image, updated at five-minute intervals.
- C. Web-Based Interface: Provide online interface to allow viewing of each high-definition digital still image captured and stored during construction, from the Internet.
 - 1. Access Control: Provide password-protected access for Project team administered by Contractor, providing current image access and archival image access by date and time, with images downloadable to viewer's device.
 - 2. Storage: Maintain images on the website for reference during entire construction period, and for not less than 30 days after final completion. Provide sufficient memory on remote server to store all Project images.
 - 3. Online Interface: Provide website interface with Project and client information and logos; calendar-based navigation interface for selecting images; pan and zoom capability within high-definition images.
 - 4. Forward and Reverse: Provide capability to browse through images, moving forward and backward in time by individual image and by day.
 - 5. Slideshow: Provide capability to automatically display current images from sites when there are three or more cameras used.
 - 6. Time-Lapse: Provide capability for online display of project time-lapse.
 - 7. Dashboard: Provide capability to view thumbnails of all cameras on one screen.
 - 8. Weather: Provide corresponding weather data for each image captured.
- D. Maintain cameras and web-based access in good working order according to web-based construction photographic documentation service provider's written instructions until final completion. Provide for service of cameras and related networking devices and software.

P2 PRODUCTS (Not Used)

P3 EXECUTION (Not Used)

END OF SECTION

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SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 01 32 33 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and final completion construction photographs.
5. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

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

1.4 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 additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with 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: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
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 Project Officer'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.

1.5 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. Paper Submittals:

1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
5. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
6. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using AIA Document G810 transmittal form.

E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

F. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
2. Web-Based Project 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.
3. Paper: Prepare submittals in paper form, and deliver to Architect.

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 reserves 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 Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 14 days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- D. 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.

1.7 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. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams 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 concurrent 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 unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 24 by 3 inches.
 3. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.
- C. Samples: Submit Samples for review of kind, 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. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 4. Web-Based Project 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.
 5. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
 6. 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.
 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing

color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Architect through Project Officer will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

- 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
- 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. 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.

F. 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.

G. 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 Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. 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.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. 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.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 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 and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM Incorporation: Incorporate delegated-design drawing and data files into BIM established for Project.
 1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.9 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.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or by indication in web-based Project 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.

1.10 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
 - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 - 2. Paper Submittals: Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
 - 3. Submittals by Web-Based Project Software: Architect will indicate, on Project 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.

P2 PRODUCTS (Not Used)

P3 EXECUTION (Not Used)

END OF SECTION

SECTION 01 35 16 - ALTERATION PROJECT PROCEDURES

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 special procedures for alteration work.

1.3 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 existing items that are not to be removed or dismantled.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.4 COORDINATION

- A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.
 - 1. Schedule construction operations in sequence required to obtain best Work results.
 - 2. Coordinate sequence of alteration work activities to accommodate the following:
 - a. Owner's continuing occupancy of portions of existing building.
 - b. Owner's partial occupancy of completed Work.
 - c. Other known work in progress.
 - d. Tests and inspections.

3. Detail sequence of alteration work, with start and end dates.
 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
 5. Use of elevator and stairs.
 6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns [and adjacent to restricted areas] . Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work.[Access to restricted areas may not be obstructed.] Plan and execute the Work accordingly.
- 1.5 PROJECT MEETINGS FOR ALTERATION WORK
- A. Preliminary Conference for Alteration Work: Before starting alteration work, the Project Officer will conduct a conference at a location to be determined.
1. Attendees: In addition to representatives of Owner, Construction Manager (if applicable), Architect, and Contractor, testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
 2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
 - a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Fire-prevention plan.
 - c. Governing regulations.
 - d. Areas where existing construction is to remain and the required protection.
 - e. Hauling routes.
 - f. Sequence of alteration work operations.
 - g. Storage, protection, and accounting for salvaged and specially fabricated items.
 - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
 - i. Qualifications of personnel assigned to alteration work and assigned duties.
 - j. Requirements for extent and quality of work, tolerances, and required clearances.
 - k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
 3. Reporting: The Project Officer will record the conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at biweekly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Construction Manager (if applicable,), Architect, and Contractor, each specialist, supplier, installer, and other entity concerned

with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.

2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
 - a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
 - b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:
 - 1) Interface requirements of alteration work with other Project Work.
 - 2) Status of submittals for alteration work.
 - 3) Access to alteration work locations.
 - 4) Effectiveness of fire-prevention plan.
 - 5) Quality and work standards of alteration work.
 - 6) Change Orders for alteration work.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 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.

1.7 INFORMATIONAL SUBMITTALS

- A. Alteration Work Subschedule:
 1. Submit alteration work subschedule within seven days of date established for commencement of alteration work.
- B. 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.
- C. Alteration Work Program: Submit 30 days before work begins.
- D. Fire-Prevention Plan: Submit 30 days before work begins.

1.8 QUALITY ASSURANCE

- A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has

completed a minimum of five recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.

1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
 - B. 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.
 - C. 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 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.
 - D. 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.
 - E. Safety and Health Standard: Comply with ANSI/ASSE A10.6.
- 1.9 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. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.

1.10 FIELD CONDITIONS

- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of measured drawings preconstruction photographs and preconstruction videotapes.
 - 1. Comply with requirements specified in Section 01 32 33 "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 that the following items have been removed:
 - 1. .
- 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.

1.11 PART 2 PRODUCTS - (Not Used)PART 3 EXECUTIONPROTECTION

- 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.

1.12 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 open-flame or welding or other high-heat equipment. 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 60 minutes 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.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

1.13 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.

1.14 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 01 32 33 "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 01 35 16

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Testing and inspection agencies and services.
- E. Control of installation.
- F. Tolerances.
- G. Manufacturers' field services.
- H. Defect Assessment.

1.2 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants 2008 (Reapproved 2014).
- B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation 2017.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry 2019.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction 2019.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection 2020.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing 2015.
- G. IAS AC89 - Accreditation Criteria for Testing Laboratories 2018.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Schedule of Tests and Inspections: Prepare in tabular form, within 30 days following mobilization, and include the following:
 - 1. Specification section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.

- D. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Conformance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- G. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
1. Submit report in duplicate within 30 days of observation to Architect for information.
 2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- 1.4 Quality Assurance
- A. Testing Agency Qualifications:
1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.
- 1.5 REFERENCES AND STANDARDS
- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the

standard, except when more rigid requirements are specified or are required by applicable codes.

- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.6 Testing and Inspection Agencies and Services

- A. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform specified testing.
 - 1. The individual specification section must clearly state that testing is the Owner's responsibility, otherwise the testing to be executed by Contractor.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
 - 1. Testing agency: Comply with requirements of ASTM E 329, ASTM E543, ASTM C1021, ASTM C1077, ASTM C1093, and ASTM D3740.
 - 2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
 - 3. Laboratory: Authorized to operate in the Commonwealth of Virginia.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.2 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.3 TESTING AND INSPECTION

- A. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 - 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 - 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 - 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- E. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.4 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of

surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and [] as applicable, and to initiate instructions when necessary.

- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.5 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not conforming to specified requirements.

END OF SECTION

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SECTION 01 42 00 - REFERENCES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. Reviewed: The term "reviewed" where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- F. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- G. Recycled Content Materials: Building materials that contain in aggregate, a minimum weighted average of post consumer or post industrial recycled content material.
- H. Post Industrial Recycled Content: Building material generated by collection of waste material or by products of the manufacturing process.
- I. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- J. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- K. Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term "experienced," when used with the term "Installer," means a person regularly engaged in this type of work, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
 - 2. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

3. Assignment of Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor.
 - a. This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.
 - L. "Provide": Furnish and install, complete and ready for the intended use.
 - M. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
 - N. Testing Laboratories: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.
- 1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION
- A. Specification Format: These Specifications are organized into Divisions and Sections based on the Construction Specifications Institute's 50 Division format and MASTERFORMAT numbering system.
 - B. Specification Content: This Specification uses certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
 1. Abbreviated Language: Language used in Specifications and other Contract Documents is the abbreviated type. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated shall be interpolated as the sense required. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and the context of the Contract Documents so indicates.
 2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.
 - a. The words "shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.
- 1.4 INDUSTRY STANDARDS
- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
 - B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - C. Conflicting Requirements: Where compliance with two or more standards is specified, and the standards may establish different or conflicting requirements for minimum quantities or quality levels. Refer requirements that are different, but apparently equal, and uncertainties to the Engineer for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Refer uncertainties to the Engineer for a decision before proceeding.
 - D. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
- 1.5 ABBREVIATIONS AND ACRONYMS
- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
 - B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
 1. ICC - International Code Council; www.iccsafe.org.
 - C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
 1. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 2. DOE - Department of Energy; www.energy.gov.
 3. EPA - Environmental Protection Agency; www.epa.gov.
 4. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 5. SD - Department of State; www.state.gov.
 6. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
- 1.6 GOVERNING REGULATIONS/AUTHORITIES
- A. The Engineer has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents. Contact authorities having jurisdiction directly for information and decisions having a bearing on the Work.
 - B. Copies of Regulations: Obtain copies of the following regulations and retain at the Project Site, available for reference by parties who have a reasonable need for such reference.
 - C. International Building Code - 2012.
 1. Current list of codes in use by Arlington County:
 - a. [ICC International Building Code/2012]
 - b. [ICC International Residential Code/2012]
 - c. [NFPA National Electrical Code/2011]
 - d. [ICC International Mechanical Code/2012]
 - e. [ICC International Fuel Gas Code/2012]
 - f. [ICC International Plumbing Code/2012]

- g. [NFPA-72/10]
 - h. [NFPA-13/10]
 - i. [ICC/ANSI A117.1/2009]
 - j. [ICC International Energy Conservation Code/2012]
 - k. [ICC International Property Maintenance Code/2012]
2. Verify current codes and standards in use by Arlington County at the following site: <https://building.arlingtonva.us/resource/building-codes-standards/> .
- D. VA Uniform Statewide Building Code - VUSBC 2012
- 1. Verify current codes in use by Arlington County at the following site: <http://www.dhcd.virginia.gov/index.php/va-building-codes/building-and-fire-codes/regulations/uniform-statewide-building-code-usbc.html> .
- E. Precast/Prestressed Concrete Institute. Parking Structures practice for design and construction.
- 1. Available from the institute - <https://www.pci.org/> .
- F. Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- 1. Available from the Organization - <https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag> .
- 1.7 SUBMITTALS
- A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Temporary telecommunications services.
- B. Temporary telephone service.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.

1.2 RELATED REQUIREMENTS

- A. Section 01 51 00 - Temporary Utilities.
- B. Section 01 52 13 - Field Offices and Sheds.
- C. Section 01 55 00 - Vehicular Access and Parking.
- D. Section 01 35 53 - Security Procedures.
- E. Section 01 57 21 - Indoor Air Quality Controls.
- F. Section 01 58 13 - Temporary Project Signage.
- G. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
 - 2. Telephone Land Lines: One line, minimum; one handset per line.
 - 3. Internet Connections: Minimum of one; DSL modem or faster.

1.4 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.5 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.6 FENCING

- A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.7 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 51 00 - TEMPORARY UTILITIES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Temporary Utilities: Electricity, lighting, heat, and water.

1.2 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls: Telephone service for administrative purposes.

1.3 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards current edition.

1.4 TEMPORARY ELECTRICITY

- A. Cost: By Contractor.
- B. Provide power service required from utility source.
- C. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.
- D. Provide main service disconnect and over-current protection at convenient location and meter.
- E. Permanent convenience receptacles may be utilized during construction.
- F. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.5 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- C. Maintain lighting and provide routine repairs.

1.6 TEMPORARY HEATING

- A. Cost of Energy: By Contractor.
- B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
- C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.7 TEMPORARY COOLING

- A. Cost of Energy: By Contractor.
- B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.

- C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Prior to operation of permanent equipment for temporary cooling purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.8 TEMPORARY WATER SERVICE

- A. Cost of Water Used: By Contractor.
- B. Provide and maintain suitable quality water service for construction operations at time of project mobilization.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 52 13 - FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary field offices for use of Architect.
- B. Temporary field offices for use of Contractor.
- C. Maintenance and removal.

PART 2 PRODUCTS

2.1 MATERIALS, EQUIPMENT, FURNISHINGS

- A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.2 CONSTRUCTION

- A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. Construction: Structurally sound, secure, weather tight enclosures for office. Maintain during progress of Work; remove when no longer needed.
- C. Lighting for Offices: 50 fc at desk top height, exterior lighting at entrance doors.

2.3 ENVIRONMENTAL CONTROL

- A. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

2.4 CONTRACTOR OFFICE AND FACILITIES

- A. Size: For Contractor's needs and to provide space for project meetings.
- B. Furnishings in Meeting Area: Conference table and chairs to seat at least eight persons; racks and files for Contract Documents, submittals, and project record documents.
- C. Other Furnishings: Contractor's option.
- D. Equipment: Six adjustable band protective helmets for visitors, one 10 inch outdoor weather thermometer .

2.5 OWNER AND ARCHITECT/ENGINEER OFFICE

- A. Separate space for sole use of Owner and Architect, with separate entrance door with new lock and two keys.
- B. Area: At least 150 sq ft, with minimum dimension of 8 ft.
- C. Minimum four 110 volt duplex convenience outlets, one on each wall.
- D. Telephone: As specified in Section 01 50 00.
- E. Furnishings:
 - 1. One desk 54 by 30 inch, with three drawers.
 - 2. One drafting table 36 by 72 inch, with one equipment drawer and a 48 inch wide parallel straight edge.
 - 3. One metal, double-door storage cabinet under table.
 - 4. Plan rack to hold working drawings, shop drawings, and record documents.
 - 5. One standard four-drawer legal size metal filing cabinet with locks and two keys per lock.
 - 6. Six linear ft of metal bookshelves.
 - 7. Two swivel arm chairs.

8. One drafting table stool.
9. One tackboard 36 by 30 inch.
10. One waste basket per desk and table.

PART 3 EXECUTION

3.1 PREPARATION

- A. Fill and grade sites for temporary structures to provide drainage away from buildings.

3.2 INSTALLATION

- A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.
- B. Parking: Two hard surfaced parking spaces for use by Owner and Architect, connected to office by hard surfaced walk.

3.3 MAINTENANCE AND CLEANING

- A. Weekly janitorial services for offices; periodic cleaning and maintenance for offices.
- B. Maintain approach walks free of mud, water, and snow.

3.4 REMOVAL

- A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION

SECTION 01 55 00 - VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Driveways, entrance and traffic routes.
- B. Parking.
- C. Existing pavements and parking areas.
- D. Permanent pavements and parking facilities.
- E. Construction parking controls.
- F. Haul routes.
- G. Traffic signs and signals.
- H. Maintenance.
- I. Removal, repair.
- J. Mud from site vehicles.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 DRIVEWAYS, ENTRANCE AND TRAFFIC ROUTES

- A. Keep driveways and entrances serving premises and site surrounding Project clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Provide continuous monitoring of site.
 - 1. Schedule deliveries to minimize use of driveways and entrances.
 - 2. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Truck deliveries shall be scheduled so that the streets adjacent to the site do not back up with delivery trucks waiting to deliver materials. Trucks must be scheduled accordingly, or wait to unload inside the fence in the project site or off the Owner's property.

3.2 PARKING

- A. Use of existing parking facilities by construction personnel is not permitted.
- B. Use of new parking facilities by construction personnel is not permitted.
- C. Do not allow heavy vehicles or construction equipment in parking areas.
- D. Arrange for temporary parking areas to accommodate construction personnel.
- E. When site space is not adequate, provide additional off-site parking.
- F. Locate as approved by Architect.

3.3 Permanent pavements and parking facilities

- A. Prior to Substantial Completion the base for permanent roads and parking areas may be used for construction traffic.
- B. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.

3.4 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and Owner's operations.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.5 HAUL ROUTES

- A. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

3.6 TRAFFIC SIGNS AND SIGNALS

- A. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
- B. Install and operate traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control, and areas affected by Contractor's operations.
- C. Relocate as work progresses, to maintain effective traffic control.

3.7 MAINTENANCE

- A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
- B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.8 REMOVAL, REPAIR

- A. Repair existing and new permanent facilities damaged by use, to original condition.
- B. Remove equipment and devices when no longer required.
- C. Repair damage caused by installation.

3.9 MUD FROM SITE VEHICLES

- A. Provide means of removing mud from vehicle wheels before entering streets.

END OF SECTION

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Latest edition of the Arlington County Construction Standards and Specifications Manual and Construction Standards Detail.

1.2 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Requirements:
 - 1. Section 31 1000 "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape at a height 6 inches above the ground for trees up to and including 4-inch size at this height and as measured at a height of 12 inches above the ground for trees larger than 4-inch size.
- B. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape at a height 54 inches above the ground line for trees with caliper of 8 inches or greater.
- C. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated with a minimum radius of 96 inches unless otherwise indicated.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at the site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
 - b. Arborist's responsibilities.

- c. Quality-control program.
- d. Coordination of Work and equipment movement with the locations of protection zones.
- e. Trenching by hand or with air spade within protection zones.
- f. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
2. Detail fabrication and assembly of protection-zone fencing and signage.
3. Indicate extent of trenching by hand or with air spade within protection zones.

C. Samples: For each type of the following:

1. Organic Mulch: 1-quart volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
2. Protection-Zone Fencing: Assembled Sample.
3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For arborist and tree service firm.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- E. Quality-control program.

1.7 QUALITY ASSURANCE

- A. Arborist Qualifications: Certified Arborist as certified by ISA.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.8 FIELD CONDITIONS

- A. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Moving or parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.

5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements:

1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch- diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch OD line posts, and 2-7/8-inch OD corner and pull posts; with 0.177-inch- diameter top tension wire and 0.177-inch diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.

- a. Height: 48 inches.

2. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi (13.8 MPa) and ultimate tensile strength of 2680 psi (18.5 MPa); secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart.

- a. Height: 48 inches.

- b. Color: High-visibility orange, nonfading.

B. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:

1. Size and Text: 8" x10".

2. Lettering: 3-inch- high minimum, black characters on white background.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Tie a 1-inch blue vinyl tape around each tree trunk at 54 inches above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.

1. Apply 4-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.

3.3 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.

2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.

3. Access Gates: Install where necessary. Adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a

manner approved by Architect. Install one sign spaced approximately every 50 feet on protection-zone fencing, but no fewer than three signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.

2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 31 2000 "Earthwork" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.

2. Cut Ends: Do not paint cut root ends.

3. Temporarily support and protect roots from damage until they are permanently

redirected and covered with soil.

4. Cover exposed roots with burlap and water regularly.

5. Backfill as soon as possible according to requirements in Section 312000 "Earthwork."

B. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by arborist.

1. Prune to remove only broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.

2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.

3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).

a. Type of Pruning: Cleaning, raising, ,reducing and thinning where indicated.

B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.

F. Chip removed branches and dispose of off-site.

3.7 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Small Trees: Provide new trees of same size and species as those being replaced for each tree that measures 6 inches or smaller in caliper size.
2. Large Trees: Provide two new trees of 3 inch caliper size for each tree being replaced that measures more than 6 inches in caliper size.

a. Species: As selected by Architect.

3. Plant and maintain new trees as specified in Section 32 9200 "Landscaping."

C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 2-inch uniform thickness to remain.

D. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch diameter holes a minimum of 12 inches deep at 24 inches on center. Backfill holes with an equal mix of augured soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 015639

SECTION 01 57 19 - TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Construction procedures to promote adequate indoor air quality during and after construction.
- B. Building flush-out after construction and before occupancy.
- C. Testing indoor air quality after completion of construction.

1.2 PROJECT GOALS

- A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
 - 1. Cleaning of ductwork is not contemplated under this Contract.
 - 2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
- B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
 - 1. Furnish products meeting the specifications.
 - 2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

1.3 REFERENCE STANDARDS

- A. ASTM D5197 - Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology) 2016.
- B. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers 2017, v1.2.
- C. EPA 600/4-90/010 - Compendium of Methods for the Determination of Air Pollutants in Indoor Air 1990.
- D. EPA 625/R-96/010b - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air 1999.
- E. SMACNA (OCC) - IAQ Guidelines for Occupied Buildings Under Construction 2007.

1.4 DEFINITIONS

- A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.
- E. Ventilation: The process of supplying and removing air to and from interior spaces by natural or mechanical means.
- F. Volatile Organic Compound (VOC): Carbon compounds that participate in atmospheric photochemical reactions, (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonates, and ammonium carbonate); the compounds vaporize (become a gas) at normal room temperatures.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA (OCC) as a guide.
 - 1. Submit not less than 60 days before enclosure of building.
 - 2. Identify potential sources of odor and dust.
 - 3. Identify construction activities likely to produce odor or dust.
 - 4. Identify areas of project potentially affected, especially occupied areas.
 - 5. Evaluate potential problems by severity and describe methods of control.
 - 6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
 - 7. Describe cleaning and dust control procedures.
 - 8. Describe coordination with commissioning procedures.
- C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
- D. Duct and Terminal Unit Inspection Report.
- E. Air Contaminant Test Plan: Identify:
 - 1. Testing agency qualifications.
 - 2. Locations and scheduling of air sampling.
 - 3. Test procedures, in detail.
 - 4. Test instruments and apparatus.
 - 5. Sampling methods.
- F. Air Contaminant Test Reports: Show:
 - 1. Location where each sample was taken, and time.
 - 2. Test values for each air sample; average the values of each set of 3.
 - 3. HVAC operating conditions.
 - 4. Certification of test equipment calibration.
 - 5. Other conditions or discrepancies that might have influenced results.

1.6 SCHEDULING

- A. Coordinate construction activities to minimize or eliminate disruption of operations in occupied portions of building.
- B. Schedule for storage, installation, and protection of all components of air distribution systems.
- C. Schedule for storage, installation, and protect of absorptive materials (woven, fibrous or porous in nature, such as carpet, ceiling tiles, insulation, and fabrics) from exposure to emissions during and after installation from materials and finishes with potential for short-term release of off-gassing volatile organic compounds.
 - 1. Highlight critical methods used to protect absorptive materials from airborne pollutants such as: dust, debris, moisture, gaseous and microbial contamination.
 - 2. Sequence installation of absorptive materials after odor-emitting activities have occurred and have been mitigated by ventilation.
- D. Do not store absorptive materials on-site if protection measures as described above cannot be ensured.
- E. Avoid building occupancy while construction related pollutants are present.
- F. Ensure proper and complete curing of concrete before covering.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.
- B. Auxiliary Air Filters:
 - 1. MERV of 8, minimum, when tested in accordance with ASHRAE 52.2, during construction.
 - 2. MERV of 13, minimum, when tested in accordance with ASHRAE 52.2, installed prior to occupancy.

PART 3 EXECUTION

3.1 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by adsorptive materials by:
 - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
 - 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. HVAC system shall be kept clean, free of dust, debris, moisture, gaseous and microbial contamination during storage, handling, installation and punch-out. Inspect all air inlets, air outlets, grilles, diffusers, plenums, and ducts upon completion of Work.
 - 1. Cover and protect (taped plastic or similar method) all exposed air inlet and outlet openings, grilles, ducts, plenums, to prevent water, moisture, dust and other contaminate intrusion.
 - 2. Apply protection immediately after installation of equipment and ducting.
 - 3. Ducting runs that require more than a single day to install shall be protected at end of each day's Work.
 - 4. Leaks in return ducts and air handlers shall be checked and repaired.
 - 5. Inspect filtration monthly and replace as needed with new media throughout the HVAC system; filtration media shall be minimum MERV 8.
 - 6. After final phase of construction, install new filtration media throughout the HVAC system; filtration media shall be minimum MERV 8.
 - 7. Cleaning of ductwork is not part of this contract; however Contractor shall bear cost of cleaning required by Owner due to failure of Contractor to protect ducts and equipment from construction pollutants as specified.
- D. Use of HVAC equipment and ductwork for ventilation during construction is not permitted:
 - 1. Provide temporary ventilation equivalent to 1.5 air changes per hour, minimum.
 - 2. Exhaust directly to outside.
 - 3. Seal HVAC air inlets and outlets immediately after duct installation.
- E. Do not store construction materials or waste in mechanical or electrical rooms.
- F. Provide direct exhaust to the exterior during installation of strong emitting materials, including touch-up activities; keep exhaust away from intakes and occupied spaces.
- G. Provide adequate ventilation of packaged dry products prior to installations. Remove from package and place in a secure, dry, well-ventilated space, free from contaminant sources and

residues. Provide a temperature range of 60 degrees F minimum to 90 degree maximum continuously during ventilations period. Do not ventilate within limits of Work unless otherwise approved by Architect.

- H. "Bake-out" or "super-heating" of spaces to accelerate the release of gaseous emissions is not permitted.
- I. Prohibit smoking and use of fossil-fueled temporary heating units inside the building and near building entrances, windows and intakes and within 25 feet of building entrances.
- J. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
 - 1. Inspect duct intakes, return air grilles, and terminal units for dust.
 - 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
 - 3. Clean tops of doors and frames.
 - 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
 - 5. Clean return plenums of air handling units.
 - 6. Remove intake filters last, after cleaning is complete.
- K. Use low-toxic pest control chemicals such as boron, if needed, unless otherwise directed.
- L. Remove spills or excess application of solvent-containing products as soon as possible. Use low-emitting cleaning agents, giving preference to Green Seal products.
- M. Keep work areas as dry as possible; replace any absorptive (dry sink) material that is exposed to moisture.
- N. Use other relevant recommendations of SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.

3.2 PATHWAY INTERRUPTION

- A. Provide negative pressurization of spaces under construction and/or demolition and positive pressurization of occupied or finished spaces while construction work proceeds in adjacent areas.
- B. Relocate pollutant sources when project equipment or staging areas coincide with critical air flow pathways and place plastic barriers to contain construction areas.
- C. Temporarily seal building, including air intakes and exhaust vents, and any other building openings, when dust-generating or strong-emitting construction products or procedures are used on the exterior of the building.
- D. Once spaces within building become occupied, work areas must remain under negative pressure. Exhaust air at a rate at least 10% greater than the rate of supply. Do not exhaust air where it can be drawn back into occupied spaces and place a continuous plastic barriers creating a seal between construction areas and occupied spaces.

3.3 INDOOR AIR QUALITY MANAGEMENT - PRIOR TO OCCUPANCY

- A. Provide Air Contaminant Testing, if testing fails, provide Building Flush-Out.

3.4 BUILDING FLUSH-OUT

- A. Perform building flush-out before occupancy, with all interior finishes installed and new filtration media in place.
- B. Do not start flush-out until:
 - 1. All construction is complete.

2. HVAC systems have been tested, adjusted, and balanced for proper operation.
 3. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
 4. New HVAC filtration media have been installed.
- C. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air until a total air volume of 14,000 cubic feet per square foot of floor area has been supplied.
1. Obtain Owner's concurrence that construction is complete enough before beginning flush-out.
 2. Maintain interior temperature of at least 60 degrees F and interior relative humidity no higher than 60 percent.
 3. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
 4. Space may be occupied following delivery of a minimum of 3,500 cubic feet of outside air per square feet of floor area to space, until the total of 14,000 cubic feet per square foot of outside air has been delivered to the space, and:
 - a. Begin ventilation at least three hours prior to daily occupancy.
 - b. Continue ventilation during all occupied periods.
 - c. Provide minimum outside air volume of 0.30 cfm per square foot or design minimum outside air rate, whichever is greater.
 5. Do not start flush-out in any area until:
 - a. All construction is complete.
 - b. HVAC systems have been tested, adjusted, and balanced for proper operation.
 - c. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
 - d. New HVAC filtration media have been installed.
- D. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

3.5 AIR CONTAMINANT TESTING

- A. Perform air contaminant testing before occupancy.
- B. Do not start air contaminant testing until:
1. All construction is complete, including interior finishes.
 2. HVAC systems have been tested, adjusted, and balanced for proper operation.
 3. Cleaning of inside of HVAC ductwork, specified elsewhere, has been completed.
 4. New HVAC filtration media have been installed.
- C. Indoor Air Samples: Collect from spaces representative of occupied areas:
1. Collect samples while operable windows and exterior doors are closed, HVAC system is running normally as if occupied, with design minimum outdoor air, but with the building unoccupied.
 2. Collect samples from spaces in each contiguous floor area in each air handler zone, but not less than one sample per 25,000 square feet; take samples from areas having the least ventilation and those having the greatest presumed source strength.
 3. Collect samples from height from 36 inches to 72 inches above floor.
 4. Collect samples from same locations on 3 consecutive days during normal business hours; average the results of each set of 3 samples.
 5. Exception: Areas with normal very high outside air ventilation rates, such as laboratories, do not need to be tested.

6. For each sampling point where maximum concentration limits are exceeded conduct flush-out with outside air and retest the specific parameter(s) that were exceeded to indicate the requirements are achieved; repeat procedure until all requirements have been met.
 7. When retesting the same building areas, take samples from at least the same locations as in first test.
- D. Outdoor Air Samples: Collect samples at outside air intake of each air handler at the same time as indoor samples are taken.
- E. Analyze air samples and submit report.
- F. Air Contaminant Concentration Limits:
1. Formaldehyde: Not more than 27 parts per billion.
 2. PM10 Particulates: Not more than 50 micrograms per cubic meter.
 3. Total Volatile Organic Compounds (TVOCs): Not more than 500 micrograms per cubic meter.
 4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: Allowable concentrations listed in Table 4-1.
 5. Carbon Monoxide: Not more than 9 parts per million and not more than 2 parts per million higher than outdoor air.
- G. Air Contaminant Concentration Test Methods:
1. Formaldehyde: ASTM D5197, EPA 625/R-96/010b Method TO-11A, or EPA 600/4-90/010 Method IP-6.
 2. Particulates: EPA 600/4-90/010 Method IP-10.
 3. Total Volatile Organic Compounds (TVOC): EPA 625/R-96/010b Method TO-1, TO-15, or TO-17; or EPA 600/4-90/010 Method IP-1.
 4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: ASTM D5197, or EPA 625/R-96/010b Method TO-1, TO-15, or TO-17.
 5. Carbon Monoxide: EPA 600/4-90/010 Method IP-3, plus measure outdoor air; measure in ppm; report both indoor and outdoor measurements.

END OF SECTION

SECTION 01 58 13 - TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project identification sign.
- B. Project informational signs.

1.2 QUALITY ASSURANCE

- A. Design sign and structure to withstand 50 miles/hr wind velocity.
- B. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

PART 2 PRODUCTS

2.1 SIGN MATERIALS

- A. Structure and Framing: New, wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.
- C. Rough Hardware: Galvanized.
- D. Paint and Primers: Exterior quality, two coats; sign background of color as selected.
- E. Lettering: Exterior quality paint, contrasting colors.

2.2 PROJECT IDENTIFICATION SIGN

- A. One painted sign, 48 sq ft area, bottom 6 feet above ground.
- B. Graphic Design, Colors, Style of Lettering: Designated by Architect.

2.3 PROJECT INFORMATIONAL SIGNS

- A. Provide signs designation construction access at entrances designated for construction access.
- B. Provide no trespassing and hard hat area signs.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
- B. Erect at designated location.
- C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
- D. Install sign surface plumb and level, with butt joints. Anchor securely.

3.2 MAINTENANCE

A. Maintain signs and supports clean, repair deterioration and damage.

3.3 REMOVAL

A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 42 00 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

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

Contract are considered requests for "substitutions." The following are not considered substitutions:

1. Substitutions requested by Bidders during the bidding period, and accepted prior to award of Contract, are considered as included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
2. Revisions to Contract Documents requested by the Owner or A/E.
3. Specified options of products and construction methods included in Contract Documents.
4. The Contractor's determination of and compliance with governing
5. regulations and orders issued by governing authorities.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- 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-connected 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 identification requirements.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

PART 2 PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
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 "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 in order to establish equivalency of proposed products. 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, which 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: ..."
 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, which 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: ..."
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 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 01 25 00 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration 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 these 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. Detailed comparison of significant qualities of proposed product with those named in the Specifications. 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.
 2. Evidence that proposed product provides specified warranty.
 3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 4. Samples, if requested.

- B. Submittal Requirements: 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.

PART 3 EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 61 16 - VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Low-emitting restrictions for product categories listed below under "DEFINITIONS."
- B. VOC-restricted products.
- C. All products of each category that are installed in the project must comply; Owner's project goals do not allow for partial compliance.

1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal procedures.

1.3 DEFINITIONS

- A. Low-Emitting Products: All products of each of the following categories when installed or applied on-site in the building interior:
 - 1. Adhesives, sealants, and sealer coatings.
 - 2. Carpet tile.
 - 3. Resilient floor coverings.
 - 4. Paints and coatings.
 - 5. Cabinet work.
 - 6. Composite wood and agrifiber products used either alone or as part of another product.
 - 7. Laminating Adhesives.
- B. Interior of Building: Within the building waterproofing envelope.
- C. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- D. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

1.4 REFERENCE STANDARDS

- A. CRI (GLP) - Green Label Plus Testing Program - Certified Products Current Edition.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Evidence of Compliance: Submit for each different product in each applicable category.
- C. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
 - 1. Adhesives, sealants, paints and coatings: VOC content as measured in grams per Liter (g/L).
 - 2. Carpet Proof of Green Label Plus certification.
 - 3. Carpet Cushion,, Proof of Green Label certification.
 - 4. Resilient Flooring System,, Proof of Floor Score certification or alternate compliance.
 - 5. Composite wood and agrifiber products,, Manufacturer declaration that product contains no added urea-formaldehyde (NAUF).
 - 6. Laminating Glues Manufacturer declaration that product contains no added urea-formaldehyde.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Adhesives applied within the building waterproofing envelope shall comply with the current VOC Content limits, as expressed in grams per liter, of South Coast Air Quality Management District (SCAQMD) Rule 1168 "Adhesive and Sealant Applications," amended January 7, 2005, or more stringent levels, as follows (Adhesives integral to waterproofing system are exempt):
 - 1. Indoor Carpet & Pad Adhesives: 50.
 - 2. Wood Flooring Adhesive: 100.
 - 3. Rubber Floor Adhesives: 60.
 - 4. Subfloor Adhesives: 50.
 - 5. Ceramic Tile Adhesives: 65.
 - 6. VCT and Asphalt Tile (& Linoleum) Adhesives: 50.
 - 7. Dry Wall and Panel Adhesives: 50.
 - 8. Cove Base Adhesives: 50.
 - 9. Multipurpose Construction Adhesives: 70.
 - 10. Structural Glazing Adhesives: 100.
 - 11. PVC Welding: 510.
 - 12. CPVC Welding: 490.
 - 13. ABS Welding: 325.
 - 14. Plastic Cement Welding: 250.
 - 15. Adhesive Primer for Plastic: 550.
 - 16. Contact Adhesive: 80.
 - 17. Special Purpose Contact Adhesive: 250.
 - 18. Structural Wood Member Adhesive: 140.
 - 19. Metal to metal substrates: 30.
 - 20. Plastic foam substrate: 50.
 - 21. Porous substrate except wood: 50.
 - 22. Wood substrate: 30.
 - 23. Fiberglass substrate: 80.
 - 24. All Other Welding & Installation Adhesives: 250.
- C. Aerosol Adhesives applied within building waterproofing envelope shall comply with the VOC Content limits, as expressed in percentage of VOCs by weight, of Green Seal (GS) Standard GS-36 "Commercial Adhesives," October 19, 2000 as follows:
 - 1. General Purpose Mist Spray: 65% VOCs by weight.
 - 2. General Purpose Web Spray: 55% VOCs by weight.
 - 3. Special Purpose Aerosol Adhesives (all types): 70% VOCs by weight.
- D. Sealants applied within building waterproofing envelope shall comply with VOC Content limits, as expressed in grams per liter, less water and exempt compounds, of SCAQMD Rule 1168 "Adhesive and Sealant Applications," amended January 7, 2005, as follows (Adhesives integral to waterproofing system are exempt):
 - 1. Architectural Sealants: 250.
 - 2. Non-membrane Roof: 300.
 - 3. Single-Ply Roof Membrane: 450.

4. Other: 420.
- E. Sealant primers applied within building waterproofing envelope shall comply with VOC Content limits, as expressed in grams per liter, less water and exempt compounds, of SCAQMD Rule 1168 "Adhesive and Sealant Applications," amended January 7, 2005, as follows:
 1. Architectural, Nonporous: 250.
 2. Architectural, Porous: 775.
 3. Other: 750.
- F. Paints and Coatings:
 1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 2. Credit EQ 4.2: VOC limits.
 - a. Flat Paints, Coatings, and Primers: VOC not more than 50 g/L.
 - b. Non-Flat Paints, Coatings, and Primers: VOC not more than 150 g/L.
 - c. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 - d. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 - e. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
 - f. Floor Coatings: VOC not more than 100 g/L.
 - g. Shellacs, Clear: VOC not more than 730 g/L.
 - h. Shellacs, Pigmented: VOC not more than 550 g/L.
 - i. Stains: VOC not more than 250 g/L.
 - j. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
 - k. Dry-Fog Coatings: VOC not more than 400 g/L.
 - l. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
 - m. Pretreatment Wash Primers: VOC not more than 420 g/L.
 3. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
 4. Evidence of Compliance: Acceptable types of evidence are:
 - a. Report of laboratory testing performed in accordance with requirements.
- G. Carpet Tile and Adhesive: Provide products having VOC content not greater than that required for CRI Green Label Plus certification.
 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current Green Label Plus Certification.
 - b. Report of laboratory testing performed in accordance with requirements.
- H. Carpet Tile and Adhesive: Provide products having VOC content as specified in Section 09 68 13.
- I. Composite Wood and Agrifiber Products and Adhesives Used for Laminating Them: Provide products having no added urea-formaldehyde resins.
 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Published product data showing compliance with requirements.
- J. Other Product Categories: Comply with limitations specified elsewhere.

- K. Carpets: Comply with testing and product requirements of the Carpet and Rug Institute Green Label Plus program.
- L. Carpet cushion: Comply with testing and product requirements of the Carpet and Rug Institute Green Label program.
- M. Hard Surface Flooring and Wall Base System (vinyl, linoleum, laminate, rubber, wood flooring - except solid unfinished wood and mineral-based integrally finished flooring): Comply with testing and product requirements of the Resilient Floor Covering Institute's FloorScore Program.
 - 1. Option 1: Comply with the testing and product requirements of the California Department of Health Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda (California Section 01350 Specification). The following are options to demonstrate compliance.
 - a. Listed in the Collaborative for High Performance Schools (CHPS) High Performance Product Database.
 - b. Certified by GREENGUARD Gold (formerly Children and Schools).

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

SECTION 01 61 16.01 - ACCESSORY MATERIAL VOC CONTENT CERTIFICATION FORM

FORM

A. Identification:

1. Project Name: _____
2. Project No.: _____
3. Architect: _____

B. Use of This Form:

1. Because installers are allowed and directed to choose accessory materials suitable for the applicable installation, there is a possibility that such accessory materials might contain VOC content in excess of that permitted, especially where such materials have not been explicitly specified.
2. Contractor is required to obtain and submit this form from each installer of work on this project.
3. For each product category listed, circle the correct words in brackets: either [HAS] or [HAS NOT].
4. If any of these accessory materials has been used, attach to this form product data and MSDS sheet for each such product.

C. VOC content restrictions are specified in Section 01 61 16.

1.2 PRODUCT CERTIFICATION

A. I certify that the installation work of my firm on this project:

1. [HAS] [HAS NOT] required the use of any ADHESIVES.
2. [HAS] [HAS NOT] required the use of any JOINT SEALANTS.
3. [HAS] [HAS NOT] required the use of any PAINTS OR COATINGS.
4. [HAS] [HAS NOT] required the use of any COMPOSITE WOOD or AGRIFIBER PRODUCTS.
5. [HAS] [HAS NOT] required the use of any LAMINATING ADHESIVES.

B. Product data and MSDS sheets are attached.

2.1 CERTIFIED BY: (Installer/Manufacturer/Supplier Firm)

- A. Firm Name: _____
- B. Print Name: _____
- C. Signature: _____
- D. Title: _____ (officer of company)
- E. Date: _____

END OF SECTION

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SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.
 - 6. Include in request:
 - a. Identification of Project.
 - b. Location and description of affected work.
 - c. Necessity for cutting or alteration.
 - d. Description of proposed work and products to be used.
 - e. Alternatives to cutting and patching.
 - f. Effect on work of Owner or separate Contractor.
 - g. Written permission of affected separate Contractor.
 - h. Date and time work will be executed.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.4 QUALIFICATIONS

- A. For survey work, employ a land surveyor registered in the Commonwealth of Virginia and acceptable to Architect. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.

1.5 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- C. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- D. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- E. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- F. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.
- G. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

PART 2 PRODUCTS

2.1 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work,

assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.3 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
 - 3. Review conflicts and compatibility issues.
 - 4. Review environmental limitations and protection.
 - 5. Examine substrates.
 - 6. Review requirements of the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related Change Orders.
 - d. Submittals.
 - e. Mockups.
 - f. Testing and inspection.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.4 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- H. Periodically verify layouts by same means.

- I. Maintain a complete and accurate log of control and survey work as it progresses.

3.5 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.6 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-conforming work.
- C. Execute cutting and patching including excavation and fill to complete the work, to uncover work in order to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit products together to integrate with other work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- J. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

- K. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- L. Make neat transitions. Patch work to match adjacent work in texture and appearance. Where new work abuts or aligns with existing, perform a smooth and even transition.

3.7 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.8 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Prohibit traffic from landscaped areas.
- H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.9 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.11 FINAL CLEANING

- A. 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.

- B. Use cleaning materials that are nonhazardous.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- E. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.
- F. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
- G. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
- H. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- I. Remove tools, construction equipment, machinery, and surplus material from Project site.
- J. Remove snow and ice to provide safe access to building.
- K. 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.
- L. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- M. Sweep concrete floors broom clean in unoccupied spaces.
- N. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
- O. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
- P. Remove labels that are not permanent.
- Q. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
- R. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- S. Replace parts subject to unusual operating conditions.
- T. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- U. Clean exposed surfaces of diffusers, registers, and grills.
- V. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

W. Leave Project clean and ready for occupancy.

END OF SECTION

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

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for limits on use of Project site.
 - 2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
 - 3. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 4. Section 02 41 19 "Selective Demolition" for demolition and removal of selected portions of the building.
 - 5. Section 07 84 13 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 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.

1.4 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.
- C. 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. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
 5. 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.
- D. Certified Surveys: Submit two copies signed by land surveyor.
- E. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. 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 products and equipment.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 EXECUTION

3.1 EXAMINATION

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

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.
- 3.2 PROTECTION OF EXISTING EQUIPMENT
- A. The Contractor shall be responsible for protection of the existing equipment at all times until the completion of the construction. The Contractor shall be responsible for replacing any damages by the Contractor or his sub-contractors. See also Section 01 50 00 Temporary Facilities and Controls
- 3.3 PREPARATION
- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00 "Project Management and Coordination."

3.4 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.5 FIELD ENGINEERING

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

- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.6 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, 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.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with

integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 01 77 00 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.7 POWER/WATER/HVAC OUTAGES

- A. Although not anticipated, the Contractor shall provide a plan and schedule for interruption of utilities including short power interruptions. Connections and transfer of power shall have performed only when arrangements are made and approved at specific times approved by the County. The contractor must take all necessary steps to minimize interruption of utilities and services that will affect occupied adjacent buildings. Power (with advanced written request and County written approval) service interruptions and/or switchover must only be performed when adjacent affected buildings will be minimally occupied.

3.8 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.9 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.10 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
 5. The Contractor shall provide continuous cleaning of the job site and any roadways, alleys, sidewalks and parking spaces used as part of their work to remove debris, other construction residue and to minimize dust and debris in the area near or adjacent to the other buildings and parking spaces in the site.
 6. The Contractor shall maintain the roadways, sidewalk and parking lots they use to access the construction area at all times. Roads must also be kept clean and safe for local vehicular and pedestrian traffic at all times. Emergency vehicles must have access at all time. All damage to existing roadways, sidewalks and surface parking caused by the Contractor and their subcontractors shall be repaired by the Contractor at their expenses.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19 "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.

3.11 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.12 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.

END OF SECTION

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 WASTE MANAGEMENT REQUIREMENTS

- A. Divert a minimum of 90 percent from landfill by weight or volume of total non-hazardous project construction, demolition and site operations waste, excluding excavated soil and land-clearing waste.
- B. Owner requires that this project generate the least amount of trash and waste possible.
- C. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- D. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- E. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
 - 1. Aluminum and plastic beverage containers.
 - 2. Corrugated cardboard.
 - 3. Wood pallets.
 - 4. Clean dimensional wood: May be used as blocking or furring.
 - 5. Land clearing debris, including brush, branches, logs, and stumps.
 - 6. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
- F. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- G. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning or incinerating on or off project site.
 - a. Waste-to-energy cannot be utilized as a landfill diversion strategy.
 - 2. Burning on the project site.
 - 3. Burying on the project site.
 - 4. Dumping or burying on other property, public or private.
 - 5. Other illegal dumping or burying.
- H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. Section 01 50 00 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- C. Section 01 60 00 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

- D. Section 01 70 00 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.
- E. Section 31 10 00 - Site Clearing: Handling and disposal of land clearing debris.

1.3 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Prior to any waste removal and within 30 days of Contract award, submit for approval a detailed Construction and Demolition Waste Management Plan as outlined in this Section:
 - 1. Analysis of estimated job-site waste to be generated, including types and quantities of compostable, recyclable and salvageable materials.
 - 2. Description of means and methods to achieve required diversion rate for compostable, recyclable, and salvageable materials, including those that may be donated to charitable organizations.
 - 3. Identification of recycling contractors and haulers proposed for use in the project and locations accepting construction waste materials or entities providing related services.

4. Comingled sorting facilities: Provide end destination and intended use for all diverted materials. Provide statement that project specific diversion rates will be provided. Visual inspection is not an acceptable method of inspection for purposes of documenting percentage of comingled waste diverted from landfill.
 - a. Optional Compliance: Provide average annual recycling rate for the facility provided by the regulating local or state government authority.
- C. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 2. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 3. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
 4. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards.
 - c. Include weight tickets as evidence of quantity.
 5. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.
- D. Final Waste Management Documentation: Submit at completion of Substantial Completion and prior to contract closeout:
 1. All information required in Monthly Report Submittals.
 2. Legible copies of on-site logs, manifests, weight tickets, and receipts.

PART 2 PRODUCTS

2.1 PRODUCT SUBSTITUTIONS

- A. See Section 01 60 00 - Product Requirements for substitution submission procedures.

- B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 60 00:
 - 1. Relative amount of waste produced, compared to specified product.
 - 2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Sum.
 - 3. Proposed disposal method for waste product.
 - 4. Markets for recycled waste product.

PART 3 EXECUTION

3.1 WASTE MANAGEMENT PROCEDURES

- A. See Section 01 30 00 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 01 50 00 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 01 60 00 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 01 70 00 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.2 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Pre-bid meeting.
 - 2. Pre-construction meeting.
 - 3. Regular job-site meetings.
- E. Records: Maintain onsite logs for each load of materials removed from site:
 - 1. Landfill Log: Include type of material, load (by weight or volume), recycling/hauling service, date accepted by landfill, and facility fee.
 - 2. Waste Diversion: Include type of material, load (by weight or volume), recycling/hauling service, date accepted by recycling service, or non-profit receiver and facility fee.
 - 3. Where comingling occurs prior to collection, track the amount of construction waste diverted from landfill based on the weight or volume of the removed co-mingled waste and provide the documentation of percentages of recycled from the sorting facility.
- F. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. Provide containers as required.
 - 2. Provide temporary enclosures around piles of separated materials to be recycled or salvaged.

3. Provide materials for barriers and enclosures that are nonhazardous, recyclable, or reusable to the maximum extent possible; reuse project construction waste materials if possible.
 4. Locate enclosures out of the way of construction traffic.
 5. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 6. If an enclosed area is not provided, clearly lay out and label a specific area on-site.
 7. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
 8. Provide bi-lingual signage.
- G. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- H. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
1. Coordinate work of recycling, composting and salvaging waste haulers with other trades.
 2. Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- I. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- J. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 01 32 33 "Photographic Documentation" for submitting final completion construction photographic documentation.
 - 2. Section 01 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 3. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 4. Section 01 79 00 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 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.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 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. 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 Owner's signature for receipt of submittals.
 5. Submit testing, adjusting, and balancing records.
 6. Submit sustainable design submittals if required for LEED Certification not previously submitted.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Before requesting inspection for certification of Substantial Completion, complete the following:
1. Submit six copies of applied repair product information, care, and warranties workmanship bonds, maintenance service agreements, final certifications, and similar documents for approval by the A/E of Record.
 2. Complete startup testing of systems and initial system commissioning (seasonal systems commissioning will occur in accordance with Specification Section 01815 "HVAC Commissioning").
 3. Three sets of black/blue line prints of the "as-built" site plan and building drawings or Digital copy as approved by the Project Officer and receive written approval from the A/E of Record that the drawings are complete.
 4. Acceptance of HVAC system performance including Building Automation Controls by Arlington County Commissioning Authority.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems as required by the Specifications.
 6. Submit operations and maintenance manuals and receive written approval from the A/E of Record that the manuals are complete.
 7. Submission of certificate of final inspection from city, county and/or state agencies in accord with applicable codes, laws and ordinances.
 8. The Contractor is responsible for securing any (partial or full) occupancy permits required by local authorities. The contractor shall obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities.
 9. Perform the first final cleaning as described herein.
 10. Obtain inspection of fire protection system (sprinkler system) by the Fire Marshal's office and Owner's Insurance Rating Bureau plus correction of any deficiencies identified by Arlington County.
 11. Provide electrical systems fully operating, inspection and acceptance by appropriate authorities.

12. All labeling shall be complete as required in the Specifications.
 13. All safety devices shall be fully operational.
 14. All pressure vessels must be inspected and approved by appropriate state and local authorities.
- D. 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 01 79 00 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- E. Validation: Submit a written request for validation of Substantial Completion. On receipt of request, Arlington County will either proceed with validation or notify Contractor of unfulfilled requirements. A/E will prepare the Certificate of Substantial Completion after substantial completion validation or will notify Contractor of items, either on Contractor's list or additional items identified by A/E, which must be completed or corrected before certificate will be issued.
- F. Upon issuance of a Certificate of Substantial Completion, the seasonal commissioning and warranty period shall begin. As a component of the warranty period, the contractor shall participate in the seasonal commissioning activities as required by Commissioning Specification Section. Seasonal commissioning shall occur regardless of the time of year in which Substantial Completion occurs.
- G. At Substantial Completion of the Contract (this does not include individual phase), the retainage, or escrow, may be reduced at the Project Officers approval (no less than 1% remaining).
- H. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Section 01 29 00 "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 pest-control final inspection report.
 - 5. 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 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.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.

1.9 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.

- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit on digital media acceptable to Architect.
- E. Warranties in Paper Form:
 - 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.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are 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. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - p. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- 3.2 REPAIR OF THE WORK
- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
 - B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00

SECTION 01 78 00 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

1.3 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Record Drawings: Comply with the following:
- C. Number of Copies: Submit copies of record Drawings as follows:
 - 1. Initial Submittal:
 - a. Retain one of first three subparagraphs below.
 - b. Submit record digital data files and one set of plots.
 - 2. Final Submittal:
 - a. Submit record digital data files and three set(s) of record digital data file plots.
- D. Record Specifications: Submit searchable, annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- E. Record Product Data: Submit searchable, annotated PDF electronic files of each Product Data submittal.
 - 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.
- F. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit searchable, annotated PDF electronic files and directories of each submittal.
- G. Certification: With each application for payment, provide written certification that Project Record Documents are current at time application is submitted.
- H. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.
- I. Operation and Maintenance Data:
 - 1. Manual Content Submittal: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

- a. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - b. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
2. Manual Format: Submit operations and maintenance manuals in the following format:
 - a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit through Newforma.
 - 1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - (a) 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.
 - (b) File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
 - 2) Enable inserted reviewer comments on draft submittals.
 - b. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
 3. Initial Manual Submittal: Submit draft copy of each manual at least 90 days calendar days before commencing demonstration and training. Architect or Owner will comment on whether general scope and content of manual are acceptable within 60 calendar days before commencing demonstration and training.
 4. Final Draft Manual Submittal: Submit revised draft copy of each manual that was found unacceptable by Architect or Owner at least 30 calendar days before commencing demonstration and training. Architect or Owner will comment or approve within 15 calendar days before commencing demonstration and training.
- J. Warranties and Bonds:
1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
 - 4. Format: Submit record Specifications as searchable, annotated PDF electronic file.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction.
 - 1. Record Prints:
 - a. 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.
 - 1) Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - 2) Accurately record information in an understandable drawing technique.
 - 3) Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - 4) Cross-reference record prints to corresponding archive photographic documentation.
 - b. Content: Types of items requiring marking include, but are not limited to, the following:
 - 1) Dimensional changes to Drawings.
 - 2) Revisions to details shown on Drawings.
 - 3) Depths of foundations below first floor.
 - 4) Locations and depths of underground utilities referenced to permanent surface improvements.
 - 5) Revisions to routing of piping and conduits.
 - 6) Revisions to electrical circuitry.
 - 7) Actual equipment locations.

- 8) Duct size and routing.
 - 9) Locations of concealed internal utilities referenced to visible and accessible features of the structure.
 - 10) Changes made by addendum.
 - 11) Changes made by Change Order or Construction Change Directive.
 - 12) Changes made following Architect's written orders.
 - 13) Details not on the original Contract Drawings.
 - 14) Field records for variable and concealed conditions.
 - 15) Record information on the Work that is shown only schematically.
- c. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - d. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - e. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - f. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
2. Record Digital File: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect. When authorized, prepare a full set of digital data files of the Contract Drawings, as follows:
 - a. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 - b. Format: Annotated PDF electronic file annotated text, optical character recognition (OCR) searchable, PDF electronic files with comment function enabled.
 - c. Incorporate changes and additional information previously marked on Record Prints. Delete, redraw, and add details and notations where applicable.
 - d. Refer instances of uncertainty to Architect for resolution.
 3. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
 - a. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 - b. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
 4. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - a. Record Prints: Organize Record Prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

- b. 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.
 - c. Identification: As follows:
 - 1) Project name.
 - 2) Date.
 - 3) Designation "PROJECT RECORD DRAWINGS."
 - 4) Name of Architect.
 - 5) Name of Contractor.
- G. Product Record Data: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
- 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. If possible, a Change Order proposal should include resubmitting updated Product Data. This eliminates the need to mark up the previous submittal.
 - 4. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
 - 5. Format: Submit record Product Data as searchable, annotated PDF electronic file.
 - a. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.
- H. Miscellaneous Record Submittals:
- 1. 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.
 - 2. Format: Submit miscellaneous record submittals as PDF electronic file.
 - a. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.
- 3.2 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY
- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
- 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

3.3 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.4 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.5 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- E. Provide servicing and lubrication schedule, and list of lubricants required.
- F. Include manufacturer's printed operation and maintenance instructions.
- G. Include sequence of operation by controls manufacturer.
- H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- I. Provide control diagrams by controls manufacturer as installed.
- J. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

- K. Lamp Submittal: Include data on all lamps labeled according to fixture type; this data shall include:
 - 1. Manufacturer.
 - 2. Lamp designation (ex. PAR38, M16, T5HO).
 - 3. Manufacturer's catalog number.
 - 4. Wattage.
 - 5. Color temperature.
 - 6. CRI.
 - 7. Beam spread.
 - 8. Initial lumens.
 - 9. Catalog spec sheet for each fixture type.
 - L. Additional Requirements: As specified in individual product specification sections.
- 3.6 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS - GENERAL
- A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
 - B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
 - C. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
 - D. Prepare data in the form of an instructional manual.
 - E. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
 - F. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
 - G. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
 - H. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
 - I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
 - J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Photocopies of warranties and bonds.
 - K. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
 - L. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume. Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
- M. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
- N. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- O. 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.
 2. Performance and design criteria if Contractor is 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.
- P. 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.
- Q. 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.
- R. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- S. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.
- 3.7 PRODUCT MAINTENANCE MANUAL
- A. Content: Organize manual into a separate section for each product, material, and finish. Section format to follow that of the Project Manual(s). Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- 3.8 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL
- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent,

and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard printed maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
 - D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
 - E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
 - F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
 - G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
 - H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
- 3.9 WARRANTIES AND BONDS
- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
 - B. General:
 - 1. Execute and provide notarized Project Warranty on form furnished by Owner.
 - 2. Provide special written warranties or guarantees or both for products, equipment, systems, and installations required by other sections of Contract Documents for duration indicated.
 - 3. Provide manufacturer's warranties or guarantees or both for products, equipment, systems, and installations required by other sections of Contract Documents for duration indicated.
 - 4. Where manufacturer's warranties or guarantees, or both expire before duration required by other sections of Contract Documents, obtain and pay for extensions as a part of Contract Price.

5. Provide all warranties or guarantees or both prior to Final Payment.
 6. Warranties or guarantees or both required by Contract Documents shall commence on date of Substantial Completion of work, or designated portion thereof, unless otherwise indicated in Certificate of Substantial Completion.
- C. Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - D. Include procedures to follow to ensure Warranties are not voided due to maintenance and operational activities,
 - E. Include procedures required to initiate warranty claims.
 - F. Provide special written warranties, manufacturer's warranties, and/or guarantees for products, equipment, systems, and installation which are required by other sections of Contract Documents for the duration indicated.
 - G. Warranties and guarantees shall commence on the date of Substantial Completion of work, or designated portion of work thereof, unless otherwise indicated in Certificate of Substantial Completion.
 - H. If Contractor cannot warrant and/or guarantee any portion of work using products or construction methods indicated in the Contract Documents, notify Architect and Owner in writing during bid period and before contracts are awarded.
 1. Indicate product or work name(s) and the reasoning to support claim.
 2. Provide names of products, method, and/or data on which substitutions can be warranted and/or guaranteed.
 3. Should Contractor fail to notify Architect, Contractor will be considered as having agreed to warrant and/or guarantee the work indicated.
 - I. Provide a fully executed and notarized Project Warranty. Owner Standard Document shall be provided.

END OF SECTION

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SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory 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 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 01 91 13 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.
 - 3. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 DEFINITIONS

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

1.4 CLOSEOUT SUBMITTALS

- A. 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 and Commissioning Authority 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. Submit on digital media acceptable to Architect by uploading to web-based project software site or by email to Architect. Enable reviewer comments on draft submittals.
 - 2. Submit three paper copies. Architect, through Construction Manager, will return two copies.
- 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 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 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.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
 - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
 - 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual,

insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.
- B. 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.
- C. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for 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.
- D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- F. 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."

1.7 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.

1.8 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. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. 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.

1.9 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.
- 1.10 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.
- 1.11 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

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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 017300 "Execution" for final property survey.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 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 record digital data files and one set(s) of plots.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit record digital data files and three set(s) of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.

- B. Record Specifications: Submit one paper copy and one annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and one annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and one annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

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. RFI's
 - b. Clarifications made in approved submittals
 - c. Dimensional changes to Drawings.
 - d. Revisions to details shown on Drawings.
 - e. Depths of foundations.
 - f. Locations and depths of underground utilities.
 - g. Revisions to routing of piping and conduits.
 - h. Revisions to electrical circuitry.
 - i. Actual equipment locations.
 - j. Duct size and routing.
 - k. Locations of concealed internal and underground utilities.
 - l. Changes made following Architect's written orders.
 - m. Details not on the original Contract Drawings.

- n. Field records for variable and concealed conditions.
 - o. Record information on the Work that is shown only schematically.
 - p. Modifications to equipment schedules, with specific attention to deviations from named "Basis of Design" vendors and equipment capacities.
 - q. Modifications to Building Automation Controls systems operating logic.
 - r. Any changes in grade and location of duct banks and appurtenances.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file.
 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 with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file and one paper copy.

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- C. Format: Submit record Product Data as annotated PDF electronic file.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 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.

1.8 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 reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

END OF SECTION

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SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SUMMARY

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Plumbing equipment.
 - 4. Electrical systems and equipment.
 - 5. Security and audio visual systems.
 - 6. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - 2. Finishes, including flooring, wall finishes, ceiling finishes.
 - 3. Fixtures and fittings.
 - 4. Items specified in individual product Sections.

1.2 SUBMITTALS

- A. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
 - 1. Format: DVD Disc.
 - 2. Label each disc and container with session identification and date.

1.3 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.

- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
- F. Coordinate demonstration and training requirements with commissioning requirements.

END OF SECTION

SECTION 01 83 16 - EXTERIOR ENCLOSURE PERFORMANCE REQUIREMENTS

PROJECT INCLUDES

1.1 SECTION SUMMARY

- A. This Section includes overall building enclosure performance requirements and testing for air infiltration.
- B. The Owner will engage a testing and inspection agency to perform building enclosure performance tests; refer to Division 01 Section Quality Requirements. Before concealing the exterior wall work obtain the required inspections of same from a testing and inspection agency.
 - 1. Contractor is to coordinate with Owners Testing Agency Viridiant as required to allow for testing specified to occur.
- C. Project scheduling shall be coordinated to indicate all exterior enclosure work to be completed prior to envelope pressure testing and before drywall completion to facilitate the improvement of leakage areas found.
- D. Standards: Comply with the applicable provisions and recommendations of the following standards below, where standards conflict the more stringent shall apply:
 - 1. American Society for Testing and Materials (ASTM):
 - a. ASTM E779, "Standard Test Method for Determining Air Leakage Rate by Fan Pressurization."
 - b. ASTM E1827, "Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door."
 - c. ASTM E283, "Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen."
 - d. ASTM E330, "Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference."

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide exterior enclosure meeting or exceeding the following performance requirements:
 - 1. Achieve 0.30 ELR.

END OF SECTION

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SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Owner's Project Requirements and Basis-of-Design Document are included by reference for information only.

1.2 SUMMARY

- A. Section Includes:
 - 1. General requirements for coordinating and scheduling commissioning activities.
 - 2. Commissioning meetings.
 - 3. Commissioning reports.
 - 4. Use of commissioning process test equipment, instrumentation, and tools.
 - 5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
 - 6. Commissioning tests and commissioning test demonstration.
 - 7. Adjusting, verifying, and documenting identified systems and assemblies.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for Commissioning Authority responsibilities.
 - 2. Section 01 33 00 "Submittal Procedures" for submittal procedure requirements for commissioning process.
 - 3. Section 01 77 00 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
 - 4. Section 01 78 23 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.
 - 5. Section 01 91 19.43 "Exterior Enclosure Commissioning" for technical commissioning requirements for exterior closure.
 - 6. Section 21 08 00 "Commissioning of Fire Suppression" for technical commissioning requirements for fire suppression.
 - 7. Section 22 08 00 "Commissioning of Plumbing" for technical commissioning requirements for plumbing.
 - 8. Section 23 08 00 "Commissioning of HVAC" for technical commissioning requirements for HVAC.
 - 9. Section 26 08 00 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.

1.3 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- B. Basis-of-Design Document: A document prepared by Architect that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.

- C. Commissioning Authority: An entity engaged by Owner, and identified in Section 01 10 00 "Summary," to evaluate Commissioning-Process Work.
- D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation of commissioning requirements.
- E. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities. The scope of the commissioning process is defined in Section 01 10 00 "Summary."
- F. Construction-Phase Commissioning-Process Completion: The stage of completion and acceptance of commissioning process when resolution of deficient conditions and issues discovered during commissioning process and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date construction-phase commissioning-process completion is achieved. See Section 01 77 00 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
 - 1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:
 - a. Completion of tests and acceptance of test results.
 - b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
 - c. Comply with requirements in Section 01 79 00 "Demonstration and Training."
 - d. Completion and acceptance of submittals and reports.
- G. Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is prepared either by the Owner or for the Owner by the Architect or Commissioning Authority.
- H. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.
- I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.
- J. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- K. Sampling Procedures and Tables for Inspection by Attributes: As defined in ASQ Z1.4.
- L. Timely Notice: Seven calendar days' notice.
- M. Pre-functional checklists (PFC): a document that includes procedures that must be completed prior to functional performance testing can take place. PFCs are provided by the Commissioning Authority and are completed by the Contractor. PFCs are distinct from manufacturer's start-up checklists.
- N. Cx Online: An online software and equipment database used by the Commissioning Team to document the commissioning process. Checklists, tests, issues logs, site reporting, equipment

database information, project files, and other information is stored and used from this site. Access to and permissions for use of the database and software is controlled by the CxA.

1.4 COMPENSATION

- A. If Architect, Commissioning Authority, other Owner's witness, or Owner's staff perform additional services or incur additional expenses due to actions of Contractor listed below, compensate Owner for such additional services and expenses.
 - 1. Failure to provide timely notice of commissioning activities schedule changes.
 - 2. Failure to meet acceptance criteria for test demonstrations.
- B. Contractor shall compensate Owner for such additional services and expenses at the standard rate (current at the time of billing) of the firm performing the services, plus per diem allowances for meals and lodging according to current U.S. General Services Administration (GSA) Per Diem Rates.

1.5 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s):
 - 1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning process.
 - 2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning process.
 - 3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning process.
 - 4. Appointed team members shall have the authority to act on behalf of the entity they represent.
- B. Members Appointed by Owner:
 - 1. Commissioning Authority, plus consultants that Commissioning Authority may deem appropriate for a particular portion of the commissioning process.
 - 2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning process.
 - 3. Architect, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning process.

1.6 INFORMATIONAL SUBMITTALS

- A. Comply with requirements in Section 01 33 00 "Submittal Procedures" for submittal procedure general requirements for commissioning process.
- B. Commissioning Plan Information:
 - 1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
 - 2. Schedule of commissioning activities, integrated with the Construction Schedule. Comply with requirements in Section 01 32 00 "Construction Progress Documentation" for the Construction Schedule general requirements for commissioning process.
 - 3. Contractor personnel and subcontractors participating in each test.
 - 4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.
- C. Commissioning schedule.
- D. Two-week look-ahead schedules.
- E. Commissioning Coordinator Letter of Authority:

1. Within 10 days after approval of Commissioning Coordinator qualifications, submit a letter of authority for Commissioning Coordinator, signed by a principal of Contractor's firm. Letter shall authorize Commissioning Coordinator to do the following:
 - a. Make inspections required for commissioning process.
 - b. Coordinate, schedule, and manage commissioning process of Contractor, subcontractors, and suppliers.
 - c. Obtain documentation required for commissioning process from Contractor, subcontractors, and suppliers.
 - d. Report issues, delayed resolution of issues, schedule conflicts, and lack of cooperation or expertise on the part of members of the commissioning team.
 - F. Commissioning Coordinator Qualification Data: For entity coordinating Contractor's commissioning activities to demonstrate their capabilities and experience.
 1. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
 - G. List test instrumentation, equipment, and monitoring devices. Include the following information:
 1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
 2. Brief description of intended use.
 3. Calibration record showing the following:
 - a. Calibration agency, including name and contact information.
 - b. Last date of calibration.
 - c. Range of values for which calibration is valid.
 - d. Certification of accuracy.
 - e. Certification for calibration equipment traceable to NIST.
 - f. Due date of the next calibration.
 - H. Test Reports:
 1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
 2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
 3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
 4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
 5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
 6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.
 - I. Construction Checklists:
 1. Material checks.
 2. Installation checks.
 3. Startup procedures, where required.
- 1.7 CLOSEOUT SUBMITTALS
- A. Commissioning Report:

1. At Construction-Phase Commissioning Completion, include the following:
 - a. Pre-startup reports.
 - b. Approved test procedures.
 - c. Test data forms, completed and signed.
 - d. Progress reports.
 - e. Commissioning issue report log.
 - f. Commissioning issue reports showing resolution of issues.
 - g. Correspondence or other documents related to resolution of issues.
 - h. Other reports required by commissioning process.
 - i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
 - j. Report shall include commissioning work of Contractor.
 - B. Request for Certificate of Construction-Phase Commissioning Process Completion.
 - C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.
- 1.8 QUALITY ASSURANCE
- A. Commissioning Coordinator Qualifications:
 1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least three projects of similar scope and complexity.
 2. Certification of commissioning-process expertise. The following certifications are acceptable. Owner reserves the right to accept or reject certifications as evidence of qualification.
 - a. Certified Commissioning Authority, by AABC Commissioning Group (ACG).
 - b. Commissioning-Process Management Professional, by American Society of Heating, Refrigerating and Air-Conditioning Engineers.
 - c. Certified Commissioning Professional, by Building Commissioning Association.
 - d. Accredited Commissioning-Process Authority Professional, by University of Wisconsin.
 - e. Accredited Commissioning-Process Manager, by University of Wisconsin.
 - f. Accredited Green Commissioning-Process Provider, by University of Wisconsin.
 - B. Calibration Agency Qualifications: Certified by The American Association for Laboratory Accreditation that the calibration agency complies with minimum requirements of ISO/IEC 17025.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.
- B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:
 1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.

2. Calibrated and certified.
 - a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
 - b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.
3. Maintain test equipment and instrumentation.
4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.
 1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
 2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.3 REPORT FORMAT AND ORGANIZATION

- A. General Format and Organization:
 1. Bind report in three-ring binders.
 2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
 3. Record report on compact disk.
 4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.
- B. Commissioning Report:
 1. Include a table of contents and an index to each test.
 2. Include major tabs for each Specification Section.
 3. Include minor tabs for each test.
 4. Within each minor tab, include the following:
 - a. Test specification.
 - b. Pre-startup reports.
 - c. Approved test procedures.
 - d. Test data forms, completed and signed.
 - e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 EXECUTION

3.1 PREPARATION

- A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.2 CONSTRUCTION CHECKLISTS

- A. Construction checklists cannot modify or conflict with the Contract Documents.
- B. Create construction checklists based on actual systems and equipment to be included in Project.
- C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.
 - 1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.
 - 2. Included optional features.
 - 3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
 - 4. Installation Checks:
 - a. Location according to Drawings and approved Shop Drawings.
 - b. Configuration.
 - c. Compliance with manufacturers' written installation instructions.
 - d. Attachment to structure.
 - e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
 - f. Utility connections are of the correct characteristics, as applicable.
 - g. Correct labeling and identification.
 - h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.
- D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.
- E. Performance Tests:
 - 1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
 - 2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
 - 3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
 - 4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
 - 5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.
- F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist,

before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify deferred construction checklists by number and title.
2. Provide a target schedule for completion of deferred construction checklists.
3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.

G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify delayed construction checklist by construction checklist number and title.
2. Provide a target schedule for completion of delayed construction checklists.
3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.3 GENERAL EXECUTION REQUIREMENTS

- A. Schedule and coordinate commissioning process with the Construction Schedule.
- B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.
- C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.
 1. Where sampling is specified, the sampling plan and procedure for the test demonstration shall be determined using ASQ Z1.4.
 2. The "lot size" in ASQ Z1.4 is the sum of the number of items to which the test demonstration applies, as described in the scope subparagraph of each test.
 3. On determination of the sample size, the samples shall be selected randomly by Owner's witness at the time of the test demonstration.
 4. Include in the Commissioning Plan a detailed list of the test demonstrations with lot and sample quantities for each test.
- D. Report test data and commissioning issue resolutions.
- E. Schedule personnel to participate in and perform Commissioning-Process Work.
- F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:
 1. Operating the equipment and systems they install during tests.
 2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.
- G. Respond to commissioning issues within 2 days using the Cx online software and database and provide narrative explanation describing plans for commissioning issue resolutions

3.4 COMMISSIONING COORDINATOR RESPONSIBILITIES

- A. Management and Coordination: Manage, schedule, and coordinate commissioning process, including, but not limited to, the following:
 1. Coordinate with subcontractors on their commissioning responsibilities and activities.

2. Obtain, assemble, and submit commissioning documentation.
3. Conduct periodic on-site commissioning meetings. Comply with requirements in Section 01 31 00 "Project Management and Coordination."
4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the Construction Schedule. Update Construction Schedule at specified intervals.
5. Review and comment on preliminary test procedures and data forms.
6. Report inconsistencies and issues in system operations.
7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
8. Direct and coordinate test demonstrations.
9. Coordinate witnessing of test demonstrations by Owner's witness.
10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others. Comply with requirements in Section 01 79 00 "Demonstration and Training."
11. Prepare and submit specified commissioning reports.
12. Track commissioning issues until resolution and retesting is successfully completed.
13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
14. Assemble and submit commissioning report.

3.5 COMMISSIONING TESTING

- A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.
- B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.
- C. Construction Checklists:
 1. Complete construction checklists as Work is completed.
 2. Coordinate with Commissioning Authority on distribution of construction checklists via Cx Online to installing contractors before they start work.
 3. Distribute construction checklists to installing contractors before they start work.
 4. Installers:
 - a. Verify installation using approved construction checklists as Work proceeds using the Cx Online software.
 - b. Complete and sign construction checklists weekly for work performed during the preceding week.
 5. Provide Commissioning Authority access to construction checklists.
- D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

- E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.
- F. Test Procedures and Test Data Forms:
1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
 2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
 3. Completed test data forms are the official records of the test results.
 4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
 5. Review preliminary test procedures and test data forms and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:
 - a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
 - b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.
 6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
 7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.
- G. Performance of Tests:
1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
 2. Perform and complete each step of the approved test procedures in the order listed.
 3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
 4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
 5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.
- H. Performance of Test Demonstration:
1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.
 2. Notify Owner's witness at least three days in advance of each test demonstration.
 3. Perform and complete each step of the approved test procedures in the order listed.
 4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
 5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration,

sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.

6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.
 - a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness, and shall note the absence of Owner's witness at the scheduled time and place.
 7. False load test requirements are specified in related sections.
 - a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Architect's written approval.
- I. Deferred Tests:
1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning Process Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:
 - a. Identify deferred tests by number and title.
 - b. Provide a target schedule for completion of deferred tests.
 2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.
 3. Where deferred tests are specified, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.
- J. Delayed Tests:
1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:
 - a. Identify delayed tests by test number and title.
 - b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.
 2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.

3. Where delayed tests are approved, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.
- K. Commissioning Compliance Issues:
1. Test results that are not within the range of acceptable results are commissioning compliance issues.
 2. Track and report commissioning compliance issues until resolution and retesting are successfully completed using the Cx Online software.
 3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
 4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:
 - a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
 - b. Submit commissioning compliance issue report form within 24 hours of the test.
 - c. Determine the cause of the failure.
 - d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.
 5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.
 - a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
 - b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
 - c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
 - d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.
 6. Diagnose and correct failed test demonstrations as follows:
 - a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
 - b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
 - c. Record the results of each step of the diagnostic procedure.
 - d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
 - e. Determine and record corrective measures.

- f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report using the Cx Online software.
- 7. Retest:
 - a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
 - b. For each repeated test demonstration, submit a new test data form, marked "Retest."
- 8. Do not correct commissioning compliance issues during test demonstrations.
 - a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.6 COMMISSIONING MEETINGS

- A. Commissioning Authority will schedule and conduct commissioning meetings. Comply with requirements in Section 01 31 00 "Project Management and Coordination."

3.7 SEQUENCING

- A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:
 - 1. Construction Checklists:
 - a. Material checks.
 - b. Installation checks.
 - c. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
 - d. Performance Tests:
 - 1) Static tests, as appropriate.
 - 2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
 - 3) Equipment and assembly performance tests.
 - 4) System performance tests.
 - 5) Intersystem performance tests.
 - 2. Commissioning tests.
- B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.
- C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.

- D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.8 SCHEDULING

- A. Commence commissioning process as early in the construction period as possible.
- B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule. See Section 01 32 00 "Construction Progress Documentation."
 - 1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.
 - 2. Schedule the start date and duration for the following commissioning activities:
 - a. Submittals.
 - b. Preliminary operation and maintenance manual submittals.
 - c. Installation checks.
 - d. Startup, where required.
 - e. Performance tests.
 - f. Performance test demonstrations.
 - g. Commissioning tests.
 - h. Commissioning test demonstrations.
 - 3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
 - 4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.
- C. Two-Week Look-Ahead Commissioning Schedule:
 - 1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
 - 2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
 - 3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.
- D. Owner's Witness Coordination:
 - 1. Coordinate Owner's witness participation via Architect.
 - 2. Notify Architect of commissioning schedule changes at least two work days in advance for activities requiring the participation of Owner's witness.

3.9 COMMISSIONING REPORTS

- A. Test Reports:
 - 1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:
 - a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
 - b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.

- c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
 - d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
 - e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.
2. Test data reports include the following:
 - a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
 - b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
 - c. Signatures of individuals performing and witnessing tests.
 - d. Data trend logs accumulated overnight from the previous day of testing.
 3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report using the Cx Online software. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:
 - a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
 - b. Action distribution list.
 - c. Report date.
 - d. Test number and description.
 - e. Equipment identification and location.
 - f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
 - g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
 - h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
 - i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
 - j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
 - k. Schedule for retesting.

4. Weekly progress reports include information for tests conducted since the preceding report and the following:
 - a. Completed data forms.
 - b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
 - c. Activities scheduled but not conducted per schedule.
 - d. Commissioning compliance issue report log.
 - e. Schedule changes for remaining Commissioning-Process Work, if any.
 5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.
 - a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
 - b. Attach to the data form printed trend log data collected during the test or test demonstration.
 - c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.
 6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."
 - a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.
- 3.10 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION
- A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority through Architect a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning process.
 - B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction-phase commissioning process or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction-Phase Commissioning Process Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction-Phase Commissioning Process Completion, complete or correct such items on notification by Commissioning Authority. In such case,

Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction-phase commissioning process completion.

- C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.
- D. When construction-phase commissioning process or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION 01 91 13

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SECTION 024113 - SELECTIVE SITE DEMOLITION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.
- B. Latest edition of the Arlington County Construction Standards and Specifications Manual and Construction Standards Detail.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of existing asphalt and/or concrete pavement, concrete and/or asphalt walks, storm structures, curbs and gutters, and other exterior site items indicated or not indicated which interfere with the Work.
 - 2. Removal and/or replacement of fencing where indicated.

1.03 DEFINITIONS

- A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
- B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.
- C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.
- D. Existing to Remain: Protect items indicated to remain against damage and soiling. When permitted by the Architect, items may be removed to a suitable, protected storage location and then cleaned and reinstalled in their original locations.

1.04 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, remove demolished materials from the site with further disposition at the Contractor's option.
- B. Storage or sale of removed items or materials on-site will not be permitted.
- C. Historical 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 the Owner, which may be encountered, remain the Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.

1.05 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the Work.
- B. Record drawings at Project closeout.

1. Identify and accurately locate capped utilities and other surface or subsurface structural, electrical, or mechanical conditions.
- C. Proposed dust-control measures.
- D. Schedule of selective demolition activities indicating the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 2. Interruption of utility services.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Detailed sequence of selective demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 6. Locations of temporary partitions and means of egress.
- E. Inventory of items to be removed and salvaged or turned over to Owner.
- F. Landfill records indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: All work shall comply with Federal, State and Local laws and regulations concerning hauling and disposal of demolition debris.
- B. Notify the proper agencies prior to the start of work and obtain all necessary permits for this work.

1.07 PROJECT CONDITIONS

- A. Owner assumes no responsibility for actual condition of items or structures to be demolished. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner to the extent practical. However, minor variations may occur due to Owner's removal and salvage operations prior to the start of demolition work.
- B. The location of existing underground utilities indicated is approximate only. Field locate all existing underground utilities in the area of work, regardless of whether or not they are indicated. Call "Miss Utility" prior to the start of demolition work for assistance in the location of existing underground utilities.
- C. Should charted, uncharted or incorrectly charted utilities be encountered during demolition, contact the Architect immediately for instructions. Cooperate with Owner and utility companies to keep services and facilities in operation.
- D. Do not interrupt existing utilities serving facilities occupied and used by the Owner and others, except when permitted in writing by the Owner. Provide acceptable temporary utility service as required to maintain Owner's operations.

1.08 SCHEDULING

- A. Notify and coordinate any required relocation and/or removal of existing underground utilities, poles, meters or other above ground appurtenances with the appropriate utility company (i.e. power, telephone, cable and natural gas/propane) prior to the start of selective demolition work.

- B. Notify and coordinate Loudon County archeologists 5 days prior to removal of all existing asphalt pavement. Coordinate with Owner and archeologists to address delays if something is found.

1.09 PAYMENT FOR UTILITY REMOVAL / RELOCATIONS

- A. Electric Service – shall be included in contract amount.
- B. Phone Service – shall be included in contract amount.
- C. Cable Television – shall be included in contract amount.
- D. Gas – shall be included in contract amount.
- E. Fiber Optic Lines – shall be included in contract amount.
- F. Private Data – shall be included in contract amount

1.010 USE OF EXPLOSIVES

- A. Do not use explosives to perform selective site demolition work.

PART 2 PRODUCTS

(Not Applicable)

PART 3 EXECUTIONS

3.1 EXAMINATION

- A. Call “Miss Utility” 48 hours prior to the start of demolition work for assistance in the location of existing underground utilities. Field locate all existing underground utilities in the area of work, regardless of whether or not they are indicated.
- B. Should uncharted or incorrectly charted existing utilities be identified, contact the Architect immediately for instructions. Provide a scale drawing with the location of the uncharted or incorrectly charted utilities for use by the Architect in preparing additional direction.
- C. Verify that utilities indicated as removed, abandoned and/or relocated have been disconnected and capped.
- D. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- E. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged and turned over to the Owner.

3.2 PROTECTION OF PERSONS AND PROPERTY

- A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.
- B. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

- C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective demolition area.
 - 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
- D. Barricade areas of demolition occurring as part of this work, and post with warning lights as required by authorities having jurisdiction.
- E. Protect structures, buildings, utilities, walks, pavements, existing vegetation and other facilities to remain from damage caused by settlement, lateral movement, undermining, washout and other hazards created by demolition operations.

3.3 POLLUTION CONTROLS

- A. Perform all work in accordance with the requirements of the latest edition of the Virginia Erosion and Sediment Control Handbook and those of the local Erosion Control official.
- B. Clean adjacent structures and improvements of dust, dirt, and debris caused by the Work. Return adjacent areas to condition existing before start of selective demolition.

3.4 DEMOLITION OF EXISTING FACILITIES

- A. Asphalt Pavement
 - 1. Remove asphalt concrete pavement by saw cutting to the full depth of the pavement. Provide neat saw cuts at the limits of pavement removal indicated.
- B. Concrete Pavement, Walks and Curbs
 - 1. Remove concrete pavement and walks to the nearest joint. Saw cut concrete if joints are not present adjacent to the area of demolition.
 - 2. Saw cut concrete along straight lines to a depth of not less than 2 inches. Break out remainder of concrete, provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through concrete.
- C. Light Poles
 - 1. Remove and relocate light poles as indicated. If light poles are owned by a public utility, coordinate the relocation with them.
- D. Fencing
 - 1. Remove existing fencing if indicated on the drawings.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Do not burn demolished materials or debris.
- C. Transport and legally dispose of demolished materials off of Owner's property.

3.6 CLEANUP AND REPAIR

- A. Upon completion of demolition work remove all tools, equipment and demolition materials from site. Remove demolition work area protection and leave areas clean.

- B. Repair any demolition performed in excess of that required. Return elements of construction and surfaces to remain to the condition existing prior to the start of construction. Repair adjacent construction or surfaces soiled or damaged by demolition work.

END OF SECTION 024113

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of building or structure.
- B. Related Sections include the following:
 - 1. Division 1 Section "Summary" for use of premises, and phasing, and Owner-occupancy requirements.
 - 2. Division 1 Section "Site Procedures and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
 - 3. Division 1 Section "Execution Requirements" for cutting and patching procedures.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- D. Demolish: Tearing down, destruction, breakup, razing or removal of the whole or part of a building or structure, or a free standing machinery or equipment that is directly related to the function of the structure.
- E. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.

1.3 SUBMITTALS

- A. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations.

1.4 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Administrative Requirements."

1.5 PROJECT 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. The procedures proposed for the accomplishment of the work should provide for the safe conduct of the work.
 - E. Hazardous Abatement: Coordinate hazardous materials management with abatement trades, as required. [OSHA 1926.850(e); ANSI A10.6]
 - 1. Determine lead concentrations in any suspect surface coatings, structural steel rust inhibitors and ceramic tiles prior to selective demolition. Coordinate lead management with abatement trade, as required. [29 CFR 1926.850(e) and 1926.62(d)(2)]
 - 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.
- 1.6 WARRANTY
- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- D. Engage a professional engineer to survey 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 demolition operations.
- E. Survey of Existing Conditions:
 - 1. Record existing conditions by use of preconstruction photographs.
 - 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.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

- A. 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.
- B. Temporary Facilities: 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. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 3. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 4. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 1 Section "Temporary Facilities and Controls."
- C. Temporary Shoring: 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.

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, to minimize disturbance of adjacent surfaces. 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 fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly.
- B. 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 small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- D. Roofing:
 1. Before commencing with cutting and patching of roofing, consult with the Owner regarding the existence of an outstanding roofing warranty. If such a warranty exists, obtain written approval of the methods to be used from the roofing manufacturer who issued the warranty so as not to affect the value of the warranty.
 2. Cut, patch, repair and extend roofing and installation as follows:
 - a. Where disturbed or damaged by alteration Work or activities related to same.
 - b. Where new Work connects to existing construction.
 3. Roof areas penetrated for alterations shall be protected against damage and leakage by the Contractor performing the Work. Roof openings shall not be left uncovered or unprotected overnight or during any periods of rainy or inclement weather.
 4. Remove loose aggregate, if applicable, and store away from work area.
 5. Work shall be performed in a manner to provide for permanent water-tight splice or repair.
 6. Roof repair and alteration Work and materials shall match existing roofing materials and construction.
 7. Upon completion and inspection of splice or repair Work, remove debris from the roof and replace the aggregate as required.
 8. Protect undisturbed existing and newly repaired roofing subject to traffic and damage.
 9. Upon completion of demolition operations requiring the shoring of roof structure, manufacturer holding the existing warranty shall inspect all base flashings and roofing membrane; perform all repairs required following demolition operations.

- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
 - 1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- F. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.
- G. Hazardous Materials:
 - 1. Coordinate hazardous materials management with abatement trades, as required." [OSHA 1926.850(e); ANSI A10.6]
 - 2. Determine lead concentrations in any suspect surface coatings, structural steel rust inhibitors and ceramic tiles prior to selective demolition. Coordinate lead management with abatement trade, as required. [29 CFR 1926.850(e) and 1926.62(d)(2)]
 - 3. CAUTION: Lamp ballasts are regulated toxic substances. PCB and DEHP WASTES shall be salvaged. [EPA 40 CFR 761]
 - 4. CAUTION: Hydraulic door closures may contain PCB oils. Recover hydraulic door closures intact for salvage and coordinated delivery to Owner. [EPA 40 CFR 761 and 29 CFR 1926.850(e)]
 - 5. CAUTION: Fluorescent tubes, batteries and tilt-switch thermostats contain MERCURY. [29 CFR 1926.850(e)]

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

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

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, not limited to but including the following:
 - 1. Footings.
 - 2. Granular fill.
 - 3. Fine graded granular fill.
 - 4. Slab on grade.
 - 5. Suspended slab.
- B. Related Requirements:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
 - 2. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.

- d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.
- E. Final Inspection Certificate.
- F. Samples: For vapor retarder.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer, 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. Floor and slab treatments.
7. Bonding agents.
8. Adhesives.
9. Vapor retarders.
10. Semirigid joint filler.
11. Joint-filler strips.
12. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 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, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4.

E. Mockups: Cast concrete slab-on-grade panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 200 sq. ft. for slab-on-grade in the location indicated or, if not indicated, as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301.
 2. ACI 117.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. 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 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. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

- F. 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.
- G. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.
- B. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- C. Deformed-Steel Wire: ASTM A 1064.
- D. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150, Type I or Type III.
 - 2. Fly Ash: ASTM C 618, Class F or C.
 - 3. Slag Cement: ASTM C 989, Grade 100 or 120.
 - 4. Blended Hydraulic Cement: ASTM C 595, Type IP, portland-pozzolan cement.
- 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: 1-1/2 inches nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Lightweight Aggregate: ASTM C 330, 1-inch nominal maximum aggregate size.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- G. 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, Type C.
- H. 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.
- I. Water: ASTM C 94 and potable.

2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A.
1. Maximum Permeance ASTM E96: 0.01 perms (English).
 2. Provide standard accessories and tape for complete system.
 3. Acceptable Products:
 - a. Basis-of-Design: Stego Wrap (15-mil) Vapor Barrier by STEGO INDUSTRIES LLC.
 - b. Perminator 15 mils by W.R. Meadows, Inc.
 - c. Moistop Ultra 15 by Fortifiber.
 4. Single ply polyethylene is prohibited.
 5. Basis-of-Design Accessories:
 - a. Seams:
 - 1) Stego Tape by Stego Industries LLC, www.stegoindustries.com.
 - b. Penetrations of Vapor barrier:
 - 1) Stego Mastic by Stego Industries LLC, www.stegoindustries.com.
 - 2) Stego Tape by Stego Industries LLC, www.stegoindustries.com.
 - c. Perimeter/edge seal:
 - 1) Stego Crete Claw by Stego Industries LLC, www.stegoindustries.com.
 - 2) Stego Term Bar by Stego Industries LLC, www.stegoindustries.com.
 - 3) StegoTack Tape (double sided) by Stego Industries LLC, www.stegoindustries.com.

2.7 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing 3/8-inch sieve.

2.8 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.9 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

- D. 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.

2.10 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. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 according to ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Slag Cement: 50 percent.
4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to 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.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

B. Foundation Walls: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

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

1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Minimum Cementitious Materials Content: 520 lb/cu. yd.
4. Slump Limit: 5 inches, plus or minus 1 inch.
5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
7. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

D. Suspended Slabs: Lightweight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Calculated Equilibrium Unit Weight: 115 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C 567.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.14 FABRICATING REINFORCEMENT

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

2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: 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. 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., increase mixing time by 15 seconds for each additional 1 cu. yd.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity,

and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, 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 for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

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

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 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 are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
 - 2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b)

where obstructed by impediments, such as dowels, waterstops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.

3. Overlap joints 6 inches and seal with manufacturer's seam tape.
4. Apply seam tape to a clean and dry vapor barrier.
5. Seal all penetrations (including pipes) per manufacturer's instructions.
6. Avoid the use of non-permanent stakes driven through vapor barrier.
7. If non-permanent stakes are driven through vapor barrier, repair as recommended by vapor barrier manufacturer.
8. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

3.5 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 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 Architect.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

3. Locate slabs.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. 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 is placed on concrete that has hardened enough to cause seams or

planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

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

3.8 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 FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
 - 1. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate 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.

3.10 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4000 psi at 28 days.
 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 LIQUID FLOOR TREATMENT APPLICATION

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than 14 days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.13 JOINT FILLING

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

3.14 CONCRETE SURFACE REPAIRS

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

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as

- original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
 - F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- 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., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete 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, 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, one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
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.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
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.
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. 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.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of

concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within hours of finishing.

3.16 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 03 54 16 - HYDRAULIC CEMENT UNDERLAYMENT**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes a self-leveling underlayment that consists of a blend of Portland cements, other hydraulic cements and polymers that is used to level and smooth interior concrete and properly prepared, non-water-soluble adhesive residue on concrete prior to the installation of finished flooring on all grade levels.
- B. This is to be applied to all existing floor slabs in the renovated area.
- C. The top elevation shall match the top elevation of the new slab on grade.
 - 1. Thickness of underlayment will vary depending on elevation of slab after demolition of existing floor materials.
- D. Related Sections include the following:
 - 1. Division 03 Concrete Sections
 - 2. Division 09 Flooring Sections

1.2 REFERENCES

- A. ASTM C109M, Compressive Strength Air-Cure Only
- B. ASTM C348, Flexural Strength of Hydraulic-Cement Mortars
- C. ASTM F2170, Relative Humidity in Concrete Floor Slabs Using in situ Probes
- D. ASTM F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used. Include manufacturer's Safety Data Sheets.
- B. Qualification Data: For Installer

1.4 QUALITY ASSURANCE

- A. Installation of the underlayment product must be completed by a factory-trained applicator, using mixing equipment and tools approved by the manufacturer.
- B. Product must have hydraulic cement-based inorganic binder content as the primary binder which includes Portland cement per ASTM C150: Standard Specification for Portland cement and other specialty hydraulic cements. Gypsum-based products are not acceptable.
- C. Manufacturer Experience: Provide products of this section by companies which have successfully specialized in production of this type of products for not less than 10 years. Contact Manufacturer Representative prior to installation.

1.5 WARRANTY

- A. Underlayment installed as part of a floor system, shall be installed in conjunction with the requirements of the manufacturer to provide a 5-Year Warranty.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in original packaging, labeled with product identification, manufacturer, batch number and shelf life.
- B. Store products in a dry area with temperature maintained between 50° and 85°F (10° and 29°C) and protect from direct sunlight.
- C. Handle products in accordance with manufacturer's printed recommendations.

1.7 PROJECT CONDITIONS

- A. Do not install material below 50°F (10°C) surface and air temperatures. These temperatures must also be maintained during and for 48 hours after the installation of products included in this section. Install quickly if substrate is warm and follow warm weather instructions available from the manufacturer.

PART 2 - PRODUCTS

2.1 HYDRAULIC CEMENT UNDERLAYMENT

- A. Basis-of-Design: Hydraulic Cement-Based Self-Leveling Underlayment System:
 1. ARDEX V 1200™; manufactured by ARDEX Americas: www.ardexamericas.com.
 - a. Primer Standard Absorbent Concrete: ARDEX P 51™ Primer
 - b. Primer Extremely Absorbent Concrete: May require two applications of ARDEX P 51
 - c. Primer non-porous substrates such as burnished concrete, properly prepared non-water soluble adhesive residue on concrete and concrete treated with approved silicate compounds: ARDEX P 82™ Ultra Prime
 2. Performance and Physical Properties: Meet or exceed the following values for material cured at 73° F+/-3°F (23° C+/-3°C) and 50% +/-5% relative humidity:
 - a. Application: Barrel Mix or Pump
 - b. Flow Time: 10 minutes
 - c. Final Set: Approx. 90 minutes
 - d. Compressive Strength: 4500 psi (315 kg/cm²) at 28 days, ASTM C109M.
 - e. Flexural Strength: 1000 psi (70 kg/cm²) at 28 days, ASTM C348.
 - f. VOC: 0
- B. Other Acceptable Manufacturers:
 1. Custom Building Products; www.custombuildingproducts.com.
 2. LATICRETE International, Inc; www.laticrete.com.
 3. UZIN, a division of UFLOOR Systems Inc; www.ufloorsystems.com.
 4. Schonox HPS North America; www.hpsubfloors.com.

2.2 WATER

- A. Water shall be clean, potable, and sufficiently cool (not warmer than 70°F).

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare substrate in accordance with manufacturer's instructions.
 1. Concrete
 - a. Prior to proceeding please refer to ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring. All concrete subfloors must be sound, solid, clean, and free of all oil, grease, dirt, certain curing compounds and any contaminant that might act as a bond breaker before priming. Mechanically clean if necessary using shot blasting or other. Acid etching and the use of sweeping compounds and solvents are not acceptable.

- b. Substrates shall be inspected in accordance with ASTM F2170 and corrected for moisture or any other conditions that could affect the performance of the underlayment or the finished floor covering. For areas where moisture vapor emissions exceed the required limits refer to Section 09 05 61.13, Moisture Vapor Emission Control and install the appropriate ARDEX Moisture Control System.
2. Crack and Joint Preparation
 - a. Moving Joints and Moving Cracks - Prepare all moving joints and moving cracks up through the underlayment with a flexible sealing compound recommended by the manufacturer.
 - b. Saw Cuts, Control Joints and Dormant Cracks - Fill all dormant joints and dormant cracks with a Low Viscosity Rigid Polyurethane Crack & Joint Repair or Self-Drying, Cement- Based Finish Underlayment as recommended by the manufacturer.
 3. Adhesive residues on concrete must first be tested to make certain they are not water-soluble. Water-soluble adhesives must be completely mechanically removed down to clean concrete. Non-water-soluble adhesives should be prepared to a thin, well-bonded residue using the wet-scraping technique as recommended by the Resilient Floor Covering Institute (www.rfci.com). The prepared residue should appear as nothing more than a transparent stain on the concrete after scraping.
 4. Other Non-Porous Substrates: The substrate must be clean and free of all waxes, sealers dust, dirt, debris and any other contaminant that may act as a bond breaker. If necessary, clean by mechanical methods such as shot blasting.

3.2 APPLICATION

- A. Examine substrates and conditions under which materials will be installed. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas from contact due to mixing and handling of materials.
- C. Priming (Basis-of-Design System):
 1. Standard Absorbent Concrete: Dilute ARDEX P 51 1:1 with water and apply evenly with a soft bristled push broom. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry to a clear, thin film (min. 3 hours, max. 24 hours). Underlayment shall not be applied until the primer is dry.
 2. Extremely Absorbent Concrete: Make an initial application of ARDEX P 51 diluted with 3 parts water using a soft push broom. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry thoroughly (1 to 3 hours) before proceeding with the standard application of primer as described above for standard absorbent concrete.
 3. Non-Porous Substrates, such as burnished concrete, terrazzo, well-bonded ceramic and quarry tile, epoxy coating systems, and properly prepared, non-water soluble adhesive residue on concrete: Prime with ARDEX P 82 Ultra Prime. Follow the mixing instructions on the container and apply with a short-nap or sponge paint roller, leaving a thin coat of primer no heavier than a thin coat of paint. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry to a clear, slightly tack film (minimum 3 hours, maximum 24 hours). Underlayment shall not be installed until primer is dry. NOTE: If a suitable acrylic curing compound has been used on the concrete, test the surface for porosity. If the concrete is porous, prime with ARDEX P 51. If it is non-porous, prime with ARDEX P 82.
- D. Mixing: Comply with manufacturer's printed instructions.
- E. Application: Comply with manufacturer's printed instructions and the following.

1. Underlayment must be installed at a minimum thickness of 1/8" (3 mm) over the highest point in the floor, which typically results in an average thickness of 1/4" (6 mm) or more over the entire floor.
2. Pour the liquid underlayment and spread in place with the Spreader. Immediately use the a smoother or spike roller to smooth the surface. Wear non-metallic cleats to avoid leaving marks in the liquid underlayment

F. Curing

1. The cure time required prior to installing finish flooring will vary with the thickness of the underlayment installation and the type of flooring being installed. Contact manufacturer regarding recommended cure times.

3.3 PROTECTION

- A. Prior to the installation of the finish flooring, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, Masonite or other suitable protection course.

END OF SECTION

SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete block.
- B. Clay facing brick.
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Lintels.
- G. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

- A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2018a.
- E. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile 2020.
- F. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile 2017.
- G. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2016a.
- H. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units 2020a.
- I. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
- J. ASTM C150/C150M - Standard Specification for Portland Cement 2020.
- K. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
- L. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.
- M. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
- N. ASTM C476 - Standard Specification for Grout for Masonry 2020.
- O. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry 2020.
- P. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
- Q. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing 2017.
- R. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls 2017.
- S. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples for Verification: For each type and color of the following:
 - 1. Face brick, in the form of straps of five or more bricks.
 - 2. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Shop Drawings:
 - 1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.Fabricated
 - 2. Flashing: Detail inside/outside corner units, sill and head conditions; end-dam conditions; base-of-wall, lintel and low roof-to-wall conditions; and other special applications.
- F. Mix Designs: For each type of mortar and grout.
 - 1. Include description of type and proportions of ingredients.
 - 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- G. Coordinate with Construction Waste Management requirements.
- H. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.
- I. Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with hot-weather requirements.
- J. Temporary Bracing Plan:
 - 1. Provide a temporary bracing plan for the information-only of the Architect; plan to be submitted minimum two weeks prior to initiating masonry Work.
 - 2. The bracing plan must be based on the Mason Contractors Association of America's Standard Practice for Bracing Masonry Walls Under Construction, and Masonry Wall Bracing Design Handbook, or another industry recognized standard.
 - 3. Bracing plan must be reviewed by a Professional Structural Engineer licensed in the Commonwealth of Virginia; Professional Structural Engineer to provide a letter certifying his review of the plan and acknowledgement of its completeness.
 - 4. The bracing plan and Professional Structural Engineer's letter must indicate project conditions unique to any referenced standard and provide for the unique bracing required for those conditions.
 - 5. Maintain one copy of any industry standard referenced within the plan, on project site.

1.5 QUALITY ASSURANCE

- A. Masonry Contractor Qualification:
 - 1. Engage a trade contractor with at least 10 years experience in masonry construction of type and scope included in the construction documents.
 - 2. Demotrate experience by submitting to the Owner a list of at least 10 masonry projects of similar size, complexity and scope.
 - 3. Submit resumes of all key personnel that will be assigned to the Project; dedicate assigned personnel to the Project for the entire scope of Work.

- B. Comply with provisions of TMS 402/602, except where exceeded by requirements of the contract documents.
 - 1. Maintain one copy of each document on project site.
 - C. Fire-Resistance Ratings: Where indicated, provide materials identical to those assemblies with fire-resistance ratings conforming to the Standard Method for Determining Fire Resistance of Concrete and Masonry Assemblies, ACI 216.1-97/TMS-0216-07, National Concrete Masonry Association TEK 7-1A, and ASTM E-119, and acceptable to authorities having jurisdiction.
 - 1. Certification of concrete masonry units for fire ratings must be provided by the National Concrete Masonry Association or qualified independent testing agency.
 - 2. Provide Letter of Certification for aggregates used in mix design assuring compliance with ASTM C 33 and ASTM C 331.
 - 3. Provide mix design and determined equivalent thickness, for units incorporating recycled content materials.
- 1.6 PRE-INSTALLATION MEETING
- A. Convene one week before starting work of this section.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
 - B. Store masonry units, cementitious materials, and preblended, dry mortar mix 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.
 - C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- 1.8 ENVIRONMENTAL REQUIREMENTS
- 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 down both sides and hold cover securely in place.
 - 2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
 - 3. Verify masonry protection at end of each day; inadequate protection by the trade contractor to be corrected or replaced by the Contractor, for proper protection; costs incurred by the Contractor is not the Owner's responsibility, but may be recovered under agreement with trade contractor.
 - B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 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 and Hot Weather Requirements: Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
 2. Special Shapes:
 - a. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - b. Provide bullnose units for outside corners, unless otherwise indicated.
 - c. Bullnose units are not to be used at areas scheduled to be covered with tile.
 3. Load-Bearing Units: ASTM C90, normal weight.
 4. Recycled Content: Provide units having a minimum fly ash content of 10 percent.
 5. Regional Material: Provide concrete block manufactured and of raw materials extracted and/or recovered within 100 miles of project site.

2.2 BRICK UNITS

- A. Manufacturers:
1. To Be Determined. Match existing. Contact Ray Murray at Capitol Brick 301.420.8484
- B. Facing Brick: ASTM C 216, Type FBX, Grade SW.
1. Size: Oversize. Match existing brick size.
 2. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
 3. Regional Material: Provide brick manufactured and of raw materials extracted and/or recovered within 500 miles of project site.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample to match existing.
- B. Packaged blend of portland cement complying with ASTM C 150, Type II/I or Type III, and hydrated lime.
1. Not more than 0.60 percent alkali.
 2. Hydrated Lime: ASTM C207, Type S.
 3. Mortar Aggregate: ASTM C144.
 4. Grout Aggregate: ASTM C404.
- C. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
1. Manufacturers:
 - a. Davis Colors, a division of Venator Materials PLC: www.daviscolors.com/#sle.
 - b. Lambert Corporation: www.lambertusa.com.

- c. Solomon Colors: www.solomoncolors.com.
 - d. ESSROC Cement Corp.; Flamingo.
 - e. Lehigh Cement Company.
- D. Admixtures: Permitted for cold- and hot-weather masonry work as permitted by referenced standards; non-chloride types.
- E. Water: Clean and potable.
- 2.4 REINFORCEMENT AND ANCHORAGE
- A. Manufacturers:
- 1. AA Wire Products Co.
 - 2. Dur-O-Wal: www.dur-o-wal.com.
 - 3. Heckman Building Products, Inc.
 - 4. Hohmann & Barnard, Inc (including Dur-O-Wal brand): www.h-b.com.
 - 5. WIRE-BOND; []www.wirebond.com/#sle.
 - 6. National Wire Products Industries.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi), deformed billet bars; galvanized.
- 1. Recycled Content: Provide steel with minimum 90 percent total recycled content, including at least 60 percent post-consumer recycled content.
 - 2. Regional Materials: Provide steel manufactured and of primary raw materials extracted or recovered within 100 mile radius of Project Site.
- C. Joint Reinforcement - General:
- 1. Provide in lengths of not less than 10 feet.
 - 2. Provide with prefabricated corner and tee units of same design type, wire thickness and finish as adjoining joint reinforcement.
- D. Single Wythe Joint Reinforcement: Ladder; ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
- E. Adjustable Multiple Wythe Joint Reinforcement: Ladder type with adjustable ties or tabs spaced at 16 in on center ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1875 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
- 1. Vertical adjustment: Not less than 2 inches.
 - 2. Fabricate so that eye is located 3 inches from face of masonry.
- F. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
- 1. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
- G. Masonry Veneer Anchors: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
- 1. Anchor plates: Designed for fastening to structural backup through sheathing by two fasteners.

- a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 - b. Fabricate sheet metal anchor sections and other sheet metal parts from minimum 14 gage, steel sheet, galvanized after fabrication.
 2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
 3. Vertical adjustment: Not less than 3-1/2 inches.
 4. Products:
 - a. Hohmann & Barnard, Inc.; BL-407 Anchor.
 - b. Construction Tie Products; CTP Veneer Anchoring System.
 5. Organic-Polymer-Coated, Steel Drill Screws:
 - a. Dril-Flex; Elco Industries, Inc.
 - b. Traxx; ITW-Buildex.
- H. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by ¼ inch thick by 24 inches long, with ends turned up 2 inches unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.
- I. Reinforcing Bar Positioners:
1. Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells, or as indicated on Drawings. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated. Provide units at all reinforced walls.
 2. Products:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
- J. Reinforcing Bar Couplers:
1. Mechanical splice connectors capable of developing intension or compression at least 125 percent of the specified yield strength of the bar.
 2. Representative Product: BarSplice Products, Inc., Tapered Threaded Grip-Twist Series.
- 2.5 FLASHINGS
- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.4 mm) thick.
 2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.6 m). Provide splice plates at joints of formed, smooth metal flashing.
 3. Fabricate through-wall flashing with drip edge, unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
 4. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
 5. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.
- B. Application: Unless otherwise indicated, use the following:
1. Where flashing is indicated to receive counterflashing, use metal flashing.

2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
 4. Where flashing is fully concealed, use metal flashing.
- C. Flexible Flashing:
1. Flexible Stainless Steel:
 - a. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to compliance with specified requirements:
 - 1) York Manufacturing, Inc.; Multi-Flash SS (Basis-of-Design)
 - 2) Illinois Products, Inc.; IPCO Stainless Steel Fabric Flashing
 - 3) Prosoco, Inc.; R-Guard SS ThruWall
 - 4) STS Coatings, Inc.; Gorilla Flash Stainless Fabric
 - 5) TK Products, Inc.; TK TWF
 - b. Characteristics:
 - 1) Type: Stainless steel core with polymer fabric laminated to one stainless steel face with non-asphalt adhesive.
 - 2) Stainless steel type: 304, ASTM A167.
 - 3) Fabric: polymer fabric; laminated back face of stainless steel core.
 - 4) Size: Manufacturer's standard width rolls.
 - c. Accessories:
 - 1) Mastic/sealant: Basis-of-Design: York Manufacturing, Inc.; UniverSeal US100.
 - (a) Type: One part 100% solids, solvent-free formulated silyl-terminated polyether (STPE), ASTM C920-11, Type S, Grade NS, Class 50.
 - 2) Outside corner and inside corner material; manufacturer's standard available units using:
 - (a) Stainless steel: 26 gauge stainless steel.
 - 3) End Dam: Product may be folded in line with the flashing material or utilize preformed end dams by manufacturer using:
 - (a) Stainless steel: 26 gauge stainless steel.
 - 4) Splice material: Basis-of-Design: York 304 SS by York; manufacturer's standard self-adhered metal material; material matching system material or use Multi-Flash Stainless Steel 6" lap piece and polyether sealant as a splice.
 - 5) Termination Bar: Basis-of-Design: York T-96 termination bar; manufacturer's standard 1" composite material bar or a 1" 26 gauge stainless steel termination bar with sealant lip.
 - 6) Weep vent protection: Basis-of-Design: York's Weep Armor; geotextile drainage fabric at least 12" in height.
 - 7) Repair and other materials/accessories: Manufacturer's standard.
 - 8) Fasteners: Domestic manufactured fastener types and sizes recommended by flashing manufacturer for intended use.
 2. Flexible Stainless Steel Drainage Plane Flashing:

- a. Product: Flash-Vent Stainless Steel by York, complete with sealants, termination bars, splice material, stainless steel corners.
 - b. Characteristics:
 - 1) Provides continuous weep vent.
 - (a) Selection of this option allows contractor to eliminate separate cavity drainage material; weep vent inserts in brick head joints are still required.
 - 2) Fire Resistant: Passes ASTM E84, Class A.
 - D. Flexible flashing will not extend beyond face of mortar joint at any time; where drip is indicated, drip to be provided by use of stainless steel drip plates.
 - E. Stainless Steel Drip Plates:
 - 1. Provide at flexible flashing locations, as indicated.
 - 2. Material: Minimum 26 gage stainless steel.
 - 3. Profile:
 - a. Provide with closed hemmed drip edge to extend past face of wall.
 - b. Provide vertical leg extending up backup wall minimum 2 inches.
 - c. Provide pitch in drip plate as indicated on Drawings.
 - d. Provide shop fabricated inside and outside corner.
 - e. At lip brick profiles, match profile with step in drip plate.
 - 4. Flexible flashing will cover drip plate; cut flush with face of mortar joint.
 - 5. Provide 1/8 inch thick sealant tape between drip plate and steel structural member.
 - 6. Bond flexible flashing to drip plate as recommended by flexible flashing manufacturer; product selection to ensure against adhesive drool beyond face of brick.
 - 7. Backer rod and sealant to be provided under drip edge per Division 7, at locations protecting steel.
 - F. Drip Plate Fasteners - CMU Backup: Use low-velocity powder actuated ballistic point fastener with pre-mounted washer; submit ICC-ES Evaluation Report under product data submittals indicating fastener selection appropriate for intended use.
 - G. Drip Plate Fasteners - Stud Backup: Corrosion-resistant screws located at every stud line.
 - H. Self-adhering Flashing Seam Tape: Flexible stainless steel; stainless steel core with polymer fabric laminated to one stainless steel face with non-asphalt adhesive.
- 2.6 ACCESSORIES
- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
 - B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to fully fill depth of air space, and designed to prevent mortar droppings from clogging cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Manufacturers:
 - 1) Mortar Net Solutions; [_____]: www.mortarnet.com/#sle.
 - 2) Keene Building Products; Product Keenestone Cut 2".
 - 3) Hohmann and Barnard, Inc.; Product Mortar Trap.
 - C. Cavity Vents: Preformed aluminum vents with sloping louvers.
 - 1. Locations: Flashing location at base of cavity wall construction.

- D. Cleaning Solution: Not harmful to masonry work or adjacent materials, as recommended by brick manufacturer.

2.7 LINTELS

- A. Concrete Lintels: Precast units made from concrete matching concrete masonry units in color, texture, and compressive strength and with reinforcing bars required to support loads indicated. Cure precast lintels by same method used for concrete masonry units.
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as required and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.8 MORTAR AND GROUT MIXES

- A. Mortar for Unit Masonry: ASTM C270, using the Property Specification.
 - 1. Masonry below grade and in contact with earth: Type M.
 - 2. Exterior, loadbearing masonry: Type S.
 - 3. Exterior, brick veneer: Type N.
 - 4. Interior, loadbearing masonry: Type N, except reinforced masonry to be Type S.
 - 5. Interior, non-loadbearing masonry: Type O or Type N (Contractor's discretion).
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
- C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.4 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 the construction immediately adjacent to opening.

- D. Do not install cracked, broken or chipped masonry units for any location to be exposed in completed work; do not install cracked, broken or chipped masonry units exceeding ASTM allowances in work to remain concealed or within mechanical or electrical spaces.
- E. 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.
- F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- I. Build non-load-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. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 46.

3.5 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Stopping and Resuming Work: Stop work by racking 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.
- D. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.
- E. Brick Units:
 - 1. Bond: 1/3 Running Bond.
 - 2. Mortar Joints: Concave.

3.6 PLACING AND BONDING

- A. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- B. Remove excess mortar and mortar smears as work progresses.
- C. Interlock intersections and external corners.
- D. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- E. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

- F. Cut mortar joints flush where wall tile is scheduled, resilient base is scheduled, cavity insulation vapor barrier adhesive is applied, or bitumen dampproofing is applied.
- G. Pointing:
 - 1. During the tooling of joints, enlarge voids and holes, and completely fill with mortar.
 - 2. Point joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance.
 - 3. Prepare joints for sealant application, where indicated.
- H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated and flexible anchors.
- I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.7 CAVITY VENTS

- A. Place cavity vents such as two consecutive vertical joints will include vent followed by a vertical joint without; repeat this placement for full length of application.
- B. Install vents in contact with flashing, full-width of head joint and uninterrupted by mortar.

3.8 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar diverter at base of cavity and at other flashing locations indicated on Drawings and as recommended by manufacturer to prevent mortar droppings from blocking cavity vents.

3.9 REINFORCEMENT AND ANCHORAGE - GENERAL

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement of this subparagraph 3 is in addition to continuous reinforcement.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.
 - 1. Provide an open space not less than 1/2 inch in width between masonry and structural member, unless otherwise indicated.
 - 2. Keep open space free of mortar and other rigid materials.

3.10 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Typical: Place masonry joint reinforcement in first and second horizontal joints above and below openings.

1. Extend minimum 16 inches each side of opening.
 2. Modify placement where flashing occurs in joint; flashing takes precedent; joint reinforcement location adjusted as accepted by Architect.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- F. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- G. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.

3.11 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
1. Extend flashings full width of openings and at least 4 inches into adjacent masonry at each end; turn up not less than 2 inches to form end dams.
 2. Carry flashing across air space behind veneer and up face of backup construction at least 8 inches to form watertight pan; extend flashing into masonry backup minimum 1-3/4 inches; secure flashing at non-masonry construction with termination bar and seal.
 3. Remove or cover protrusions or sharp edges that could puncture flashings.
 4. Embed flashings in mortar joint; place flashing on sloping bed of fresh mortar and cover with fresh mortar
 5. Seal lapped seams of stainless steel drip plates with self-adhering flashing seam tape; stop self-adhering flashing seam tape 3/8 inch of brick face and extend over turned up edge 3 inches onto backup construction; center tape on overlapping edge.
 6. Seal lapped ends and penetrations of flashing with adhesive or sealant, as recommended by flashing manufacturer, before covering with mortar.
- B. Lap end joints of flashings at least 6 inches and seal watertight as recommended by flashing manufacturer.
- C. Cut flashing flush with face of mortar joint after masonry construction is complete and inspected.

3.12 LINTELS

- A. Install loose steel lintels over openings.
- B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.

3.13 GROUTED COMPONENTS

- A. Lap splices minimum 48 bar diameters.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

- D. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.14 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 48 inches.

3.15 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.16 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. 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.
- E. Do not build into masonry construction organic materials that are subject to deterioration.

3.17 TOLERANCES

- A. Maximum Variation from Alignment of Columns: 1/4 inch.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/8 inch, plus 1/8 inch.

3.18 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, and conduit. Coordinate with other sections of work to provide correct size, shape, and location.

3.19 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Clay Masonry Unit Tests: Test each variety of clay masonry in accordance with ASTM C67/C67M requirements, sampling 5 randomly chosen units for each 50,000 installed.
- C. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
- D. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.
 - 1. Test three samples for each 5,000 square feet of wall or portion thereof; test one sample at 7 days and two at 28 days for each set.

3.20 REPAIRING WORK

- 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.

3.21 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.22 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Structural steel.
- 2. Grout.

- B. Related Requirements:

- 1. Section 053100 "Steel Decking" for field installation of shear 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.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

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

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand critical welds.
- D. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, professional engineer testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Shop primers.
 - 3. Nonshrink grout.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE or Category CSE.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, Endorsement P2, Endorsement P3 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 341 and AISC 341s1.
 - 3. AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC 360.
 - 2. Use Allowable Stress Design; data are given at service-load level.

2.2 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A 992/A 992M, Grade 50.
- C. Channels, Angles, ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36/A 36M.
- E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
 - 1. Weight Class: As indicated.
 - 2. Finish: Black except where indicated to be galvanized.
- G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.
 - 1. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436, Type 1, hardened carbon steel.

4. Finish: Plain.

C. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain.

2.4 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 1. Fabricate beams with rolling camber up.
 2. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 3. Mark and match-mark materials for field assembly.
 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
 - 6. Surfaces enclosed in interior construction.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 3. Ultrasonic Inspection: ASTM E 164.
 4. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Roof deck.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
- 2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
- 3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
- 4. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.

- 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

- B. Product Certificates: For each type of steel deck.

- C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

D. Evaluation Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

C. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.

D. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. 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 according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] <Insert number> percent.

2.2 ROOF DECK

- 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. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Cordeck.
6. DACS, Inc.
7. Epic Metals Corporation.
8. Marlyn Steel Decks, Inc.
9. New Millennium Building Systems, LLC.
10. Nucor Corp.; Vulcraft Group.
11. Roof Deck, Inc.
12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
13. Verco Manufacturing Co.
14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 80 zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
6. Span Condition: As indicated.
7. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

- A. General: 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 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, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- G. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.
- L. 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 according to applicable specifications and commentary in SDI Publication No. 31, 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.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- 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 according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- 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 long, and as follows:
 - 1. Weld Diameter: 5/8 inch, 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 as indicated.
 - 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, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to 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.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

END OF SECTION 053100

SECTION 05 40 00 - COLD-FORMED METAL FRAMING**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Formed steel stud exterior wall framing.
- B. Formed steel joist framing and bridging.
- C. Any other framing identified on the drawings as Cold-Formed Metal Framing.

1.2 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members 2012.
- B. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2020.
- F. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members 2018, with Editorial Revision.
- G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- I. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).
- J. International Building Code.

1.3 DESIGN REQUIREMENTS

- A. Axial and wind load bearing elements shall be designed to the following conditions unless more stringent requirements are imposed by governing code; these requirements take precedent when more stringent than governing code.
 - 1. Live/Snow Loads on Roofs: Per Code.
 - 2. Dead Load - Pitched Roof Rafters or Trusses: Total of all permanently installed material including roofing, structural frame, accessories and all equipment that is fixed in position.
 - 3. Wind Loads: Loads specified in pressure study prepared by the licensed Professional Engineer.
 - 4. Gravity loads should be per ASCE 7.
- B. Maximum Allowable Deflection:
 - 1. Backing of Masonry Veneer: 1: 600.
 - 2. Other Systems: 1: 240 of span.
- C. Wall and General System:
 - 1. Design to AISI SG-973 Cold-Formed Steel Design Manual.

2. Design to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
3. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
4. Design to meet loading and anchorage requirements for window systems and curtainwall system must be based on calculations provided by the respective subcontractors.
5. Design cold-formed metal truss framing for exterior soffits to meet applicable wind uplift requirements.
6. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as in accordance with IBC code.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
- C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
 1. Indicate stud, ceiling joist, roof joist, roof rafter, and roof truss layout.
 2. Describe method for securing studs to tracks and for bolted framing connections.
 3. Provide calculations for loadings and stresses of specially fabricated framing, stamped by a Professional Structural Engineer licensed in {GT#0}, who is responsible for its preparation.
 4. Provide details, shop drawings and calculations for factory-made framing connectors, stamped by a Professional Structural Engineer licensed in {GT#0}, who is responsible for its preparation.

1.5 QUALITY ASSURANCE

- A. Calculate structural properties of framing members in accordance with requirements of AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
 1. Maintain one copy of document on project site.

1.6 PROJECT CONDITIONS

- A. Verify that field measurements are as indicated on the drawings.

PART 2 PRODUCTS

2.1 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

2.2 FRAMING MATERIALS

- A. Recycled Content: Provide steel with at least 25 percent post-consumer recycled content.
- B. Regional Materials: Provide 25 percent of steel manufactured and containing recycled raw materials recovered within 100 mile radius of Project Site.
- C. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.

1. Gage and Depth: As required to meet specified performance levels.
 2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
 3. Provide components fabricated from ASTM A1008/A1008M Designation SS (structural steel).
- D. Joists and Purlins: Fabricated from ASTM A653/A653M steel sheet, with G90/Z275 hot dipped galvanized coating.
1. Base Metal: Structural Steel (SS) Grade 33/230 minimum.
 2. Gage and Depth: As required to meet specified performance levels.
- E. Framing Connectors: Factory-made, formed steel sheet.
1. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
 2. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
 - a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
 - b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
 - c. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 10 feet.
 - d. Acceptable Products: VertiClip(r) or DriftClip(tm) manufactured by The Steel Network Inc.
 3. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
- 2.3 ACCESSORIES
- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
 - B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- 2.4 FASTENERS
- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
 - B. Anchorage Devices: Powder actuated.
 - C. Welding: In conformance with AWS D1.1/D1.1M.
- 2.5 SHOP FABRICATED ASSEMBLIES
- A. Shop fabricate metal framing to the greatest extent possible.
 - B. Fabricate assemblies of framed sections of sizes and profiles required; with framing members fitted, reinforced, and braced to suit design requirements.
 - C. Fit and assemble in largest practical sections for delivery to site, ready for installation.

PART 3 EXECUTION

3.1 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
- B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.
- C. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- D. Install load bearing studs full length in one piece. Splicing of studs is not permitted.
- E. Install load bearing studs, brace, and reinforce to develop full strength and achieve design requirements.
- F. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- G. Install intermediate studs above and below openings to align with wall stud spacing.
- H. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
- I. Attach cross studs to studs for attachment of fixtures anchored to walls.
- J. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- K. Touch-up field welds and damaged galvanized surfaces with primer.

3.2 INSTALLATION OF JOISTS AND PURLINS

- A. Install framing components in accordance with manufacturer's instructions.
- B. Make provisions for erection stresses. Provide temporary alignment and bracing.
- C. Set floor and ceiling joists parallel and level, with lateral bracing and bridging.
- D. Locate joist end bearing directly over load bearing studs or provide load distributing member to top of stud track.
- E. Provide web stiffeners at reaction points.
- F. Touch-up field welds and damaged galvanized surfaces with primer.

3.3 TOLERANCES

- A. Maximum Variation from True Position: 1/8 inch.
- B. Maximum Variation of any Member from Plane: 1/8 inch.

3.4 FIELD QUALITY CONTROL

- A. Engage a qualified independent testing and inspection agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Perform inspections in order to assure strict conformance to the shop drawings at all phases of construction.
 - 2. Check members for proper alignment, bearing, completeness of attachments, proper alignment, reinforcement, etc.
 - 3. Check attachments for conformance with the shop drawings; all welds shall be touched up as specified.
 - 4. Complete general inspection of structure prior to applying loads to those members.

5. Inspections where and as required by local codes shall be controlled inspections.

END OF SECTION

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 04 20 00 - Unit Masonry: Placement of anchors in masonry.
- C. Section 09 21 16 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.
- D. Section 09 21 16 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.3 REFERENCE STANDARDS

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- B. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2016.
- C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021.
- D. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2015.
- E. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2013, with Editorial Revision.
- F. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings 2000 (Reapproved 2006).
- G. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2007.
- H. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
 - 1. Non-welded field connections in aluminum handrails to be limited to greatest fabricated section lengths; locations accepted by Architect and consistent for multiple locations.

1.5 QUALITY ASSURANCE

- A. Mock-up: Build mock-up section of guardrail with attached handrail to demonstrate aesthetic effects and set quality standards for fabrication and erection.
 - 1. Size: 42 inches high x 48 inches wide.

PART 2 PRODUCTS

2.1 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.
- B. Design railing assembly, wall rails, and attachments to resist lateral force of 75 lbs at any point without damage or permanent set. Test in accordance with ASTM E 935.
- C. Allow for expansion and contraction of members and building movement without damage to connections or members.
- D. Dimensions: See drawings for configurations and heights.
 - 1. Infill: Round vertical pickets; size and spacing indicated on drawings.
- E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 - 1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
 - 2. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.
 - 3. For anchorage to stud walls, provide backing plates, for bolting anchors.
- F. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.2 STAINLESS STEEL RAILING SYSTEM

- A. Tubing: ASTM A 554, Grade MT 304.
- B. Pipe: ASTM A 312/A 312M, Grade TP 304.
- C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
- D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.
- E. Bars and Shapes: ASTM A 276, Type 304.

2.3 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A 53/A 53M Grade B Schedule 40, black finish.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- D. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.4 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Close exposed ends of railing members with prefabricated end fittings.
- E. 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.

- F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
 - 2. Wall brackets for aluminum railing may be cast aluminum or stainless steel; wall brackets for aluminum rails connecting to steel guardrail systems must be stainless steel and also used for wall-mounted handrails in same area.
- G. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- H. 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.
- I. Welded Joints:
 - 1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 - 2. Interior Components: Continuously seal joined pieces by continuous welds.
 - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
 - 4. Select proper welding method to result in consistent finish with final finish.
- J. Stainless Steel Handrail Field Joints:
 - 1. Fabricate sleeves for tight press fit; keep sleeves round.
 - 2. Cut handrail ends square and to accurate length to assure smooth, tight joints.
 - 3. Fasteners: Type 304 stainless-steel tamper-resistant flat head fasteners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Handrail Field Joints:
 - 1. Clean area to be joined thoroughly.
 - 2. Apply epoxy adhesive to inside of pipe.

3. Insert sleeve and fit components together, wipe excessive adhesive.
4. Provide stainless steel set screws concealed on underside of handrail; fill head with epoxy setting adhesive and clean excess.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preservative treated wood materials.
- B. Fire retardant treated wood materials.
- C. Miscellaneous framing and sheathing.
- D. Communications and electrical room mounting boards.
- E. Concealed wood blocking, nailers, and supports.
- F. Miscellaneous wood nailers, furring, and grounds.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing 2010 (Reapproved 2017).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- D. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.
- E. PS 1 - Structural Plywood 2009.
- F. PS 20 - American Softwood Lumber Standard 2020.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials and application instructions.

1.5 QUALITY ASSURANCE

- A. Forest Certification: Provide wood products made from forests certified by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.
- C. Composite wood installed within the building interior: Comply with California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM), Phase II for ultra-low-emitting formaldehyde (ULEF) resins or contain no added formaldehyde resins.
- 2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS
- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
1. Lumber: S4S, No. 2 or Standard Grade.
 2. Boards: Standard or No. 3.
- 2.3 CONSTRUCTION PANELS
- A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- 2.4 ACCESSORIES
- A. Fasteners and Anchors:
1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- 2.5 FACTORY WOOD TREATMENT
- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
1. Exterior Type: AWWA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat all exterior rough carpentry items.
 - c. Do not use treated wood in direct contact with the ground.

- d. Treat wood blocking installed in built-up thickness for roofing terminations except top layer in direct contact with roofing membrane.
 - e. Basis-of-Design: Hoover-X by Hoover Treated Wood Products, Inc.: www.frtw.com.
2. Interior Type A: AWWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Treat rough carpentry items as indicated .
 - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
- C. Preservative Pressure Treatment of Lumber Above Grade: AWWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 2. Treat lumber in contact with roofing, flashing, or waterproofing.
 3. Treat lumber in contact with masonry or concrete.
 4. Treat lumber less than 18 inches above grade.
 5. Treat lumber in other locations as indicated.
 6. Preservative Pressure Treatment of Plywood Above Grade: AWWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
 - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
 - b. Treat plywood in contact with roofing, flashing, or waterproofing.
 - c. Treat plywood in contact with masonry or concrete.
 - d. Treat plywood less than 18 inches above grade.
 - e. Treat plywood in other locations as indicated.
- D. Preservative Pressure Treatment of Lumber in Contact with Soil: AWWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
1. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA) in exposed exterior applications subject to leaching.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.2 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

3.3 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.

END OF SECTION

SECTION 06 20 00 - FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Finish carpentry items.
- B. Hardware and attachment accessories.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard 2016.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014, with Errata (2018).
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).
- E. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.
- F. AWPA C2 - Lumber, Timber, Bridge Ties and Mine Ties -- Preservative Treatment by Pressure Processes; American Wood-Preservers' Association; 2003.
- G. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2016.
- H. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- I. NHLA G-101 - Rules for the Measurement & Inspection of Hardwood & Cypress 2015.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide data on fire retardant treatment materials and application instructions.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, accessories, to a minimum scale of 1-1/2 inch to 1 ft.
- D. Samples: Submit two samples of finish plywood, 6 by 6 inch in size illustrating wood grain and specified finish.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Custom grade.
- B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
- C. Forest Certification: Provide wood products made from forests certified by an FSC-accredited certification body. All non-FSC wood in assemblies with FSC-certified wood shall meet the FSC Controlled Wood (CW) criteria.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire retardant requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.

1.8 PROJECT CONDITIONS

- A. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- B. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY ITEMS

- A. Interior Woodwork Items:
 - 1. Plastic Laminate Shelving on wall brackets.
 - 2. Other items as indicated on the drawings.
- B. Recycled Content: Provide particleboard and MDF with minimum 80 percent recycled content.
- C. Composite wood installed within the building interior: Comply with California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM), Phase II for ultra-low-emitting formaldehyde (ULEF) resins or containing no added formaldehyde resins.

2.2 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.3 LUMBER MATERIALS

- A. Hardwood Lumber: Maple species, plain sawn, maximum moisture content of 6 percent , of quality suitable for transparent finish.
 - 1. Grading: In accordance with NHLA G-101 Grading Rules; www.nhla.org.

2.4 SHEET MATERIALS

- A. Hardwood Plywood: HPVA HP-1, Grade AA, Type II ; Veneer core, type of glue recommended for application; Maple face species, rotary cut.
- B. Particleboard: ANSI A208.1; Composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.

2.5 PLASTIC LAMINATE MATERIALS

- A. Plastic Laminate: NEMA LD 3, HGS; textured, low gloss finish.
- B. Laminate Backing Sheet: NEMA LD 3, BKL; undecorated plastic laminate.
- C. Laminate Adhesive: Type recommended by laminate manufacturer to suit application; not containing formaldehyde or other volatile organic compounds.

2.6 ADHESIVE

- A. Adhesive: Type recommended by laminate manufacturer to suit application .

2.7 ACCESSORIES

- A. Wood Filler: Solvent base, tinted to match surface finish color.

2.8 HARDWARE

- A. Standard Shelf Brackets:
 - 1. Material: Steel.
 - 2. Finish: Manufacturer's standard, factory-applied powder coat.
 - 3. Color: Selected by Architect from manufacturer's standard range.

4. Products:
 - a. A&M Hardware, Inc ; Standard Brackets: <http://www.aandmhardware.com/#sle>.
 - b. Approved equal.

2.9 WOOD TREATMENT

- A. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
- B. Wood Preservative by Pressure Treatment (PT Type): AWWPA Treatment C2 using water borne preservative with 0.25 percent retainage.
- C. Provide identification on fire retardant treated material.
- D. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.
- E. Redry wood after pressure treatment to maximum 19 percent moisture content.

2.10 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. Fit exposed sheet material edges with 3/8 inch matching hardwood edging. Use one piece for full length only.
- C. Cap exposed plastic laminate finish edges with 3mm polyvinylchloride (PVC) machine applied with hot melt adhesive inside/outside length radiused corner radiused and buffed.
 1. Color selection for PVC edging will be made at a later date; Architect reserves the right to select colors manufactured and offered by Woodtape Edge Banding (at no additional cost to the Owner), when a standard selection offered by the casework manufacturer does not provide a suitable color in the Architect's opinion.
- D. Shop prepare and identify components for book match grain matching during site erection.
- E. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- F. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
- G. Apply laminate backing sheet to reverse face of plastic laminate finished surfaces.

2.11 SHOP FINISHING

- A. Apply wood filler in exposed nail and screw indentations.
- B. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.
- C. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 1. Transparent: Conversion varnish (formerly TR-4).
 2. Opaque: Catalyzed polyurethane (formerly OP-6).
- D. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.

3.2 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.3 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Bituminous dampproofing.

1.2 REFERENCE STANDARDS

- A. NRCA (WM) - The NRCA Waterproofing Manual 2005.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide properties of primer, bitumen, and mastics.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Henry Company.
- B. Karnak Corporation: www.karnakcorp.com/#sle.
- C. W. R. Meadows, Inc: www.wrmeadows.com/#sle.

2.2 FIBERED TROWEL MASTIC

- A. Blend of selected asphalts, fibers, stabilizers, fillers and solvents.
- B. Project Standard:
 - 1. Henry 793.
 - 2. Karnak 86AF Fibered Trowel Mastic.
 - 3. WR Meadows Sealmastic Trowel Mastic.
- C. Characteristics:
 - 1. Solvent-based.
 - 2. ASTM D4586 Type 1 (Non-Asbestos).
 - 3. Perm Rating: 0.25 metric perms @ 40 mils dry film or better.

2.3 FIBERED TROWEL-GRADE EMULSION MASTIC - CONTRACTOR OPTION

- A. Blend of refined asphalt, clay emulsifiers and selected non-asbestos fibers.
- B. Project Standard:
 - 1. Henry HE 785.
 - 2. Karnak 920AF Fibered Emulsion Mastic.
 - 3. W.R. Meadows Sealmastic Type 3 Trowel-On Grade.
- C. Characteristics:
 - 1. Select this option when applying dampproofing to concrete that has cured less than 28 days or contains greater than 5 percent moisture content.

2. Water-based emulsion.
3. ASTM D1227 Type II, Class 1.
4. Permeability: 0.5 mg/sq. cm or better.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.2 PREPARATION

- A. Protect adjacent surfaces not designated to receive dampproofing.
- B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
- C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.3 APPLICATION

- A. Prime surfaces in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- B. Apply in one trowel coat, continuous and uniform, at minimum rate of 4 gal/100 sq ft.; apply free of pinholes or holidays.
- C. Seal items watertight with mastic, that project through dampproofing surface.
- D. Allow film to cure at least 48 hours prior to backfilling; backfilling must take place within 7 days of application.
- E. Notify Architect at completion of application and offer the opportunity for inspection prior to backfilling.

END OF SECTION

SECTION 07 14 00 - FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fluid-Applied Waterproofing:
 - 1. Water-based asphalt emulsion waterproofing.

1.2 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
- B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016.
- C. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers 2017.
- D. ASTM D6506 - Standard Specification for Asphalt Based Protection for Below-Grade Waterproofing 2001 (Reapproved 2009).
- E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
- F. NRCA (WM) - The NRCA Waterproofing Manual 2005.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for membrane.
- C. Warranty:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Submit installer's certification that installation complies with warranty conditions for the waterproofing membrane.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until cured for water based systems.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Contractor shall correct defective Work within a two year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no cost to Owner.
- C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.1 FLUID APPLIED WATERPROOFING MATERIALS

- A. Water-Based Asphalt Emulsion Waterproofing:
 - 1. For use when temperatures are 40 degrees fahrenheit and rising, and in accordance with manufacturers instructions.
 - 2. Cured Thickness: 60 mils, 0.060 inch, minimum.
 - 3. Suitable for installation over concrete and concrete masonry substrates.
 - 4. Elongation: Not less than 500 percent, measured in accordance with ASTM D412.
 - 5. VOC Content: Less than 30 g/L when tested in accordance with 40 CFR 59, Subpart D (EPA Method 24).
 - 6. Maximum Water Vapor Permeability: 0.1 perm inch, measured in accordance with ASTM E96/E96M.
 - 7. Peel Adhesion: According to ASTM D412, for the following substrates.
 - a. Concrete and Concrete Masonry: Minimum 10 pound-inches.
 - 8. Adhesion: Greater than 16 psi, measured in accordance with ASTM D4541.
 - 9. Products:
 - a. Carlisle Coatings & Waterproofing, Inc; BarriCoat-R or -
S: www.carlisleccw.com/#sle.
 - b. W. R. Meadows, Inc; MEL-ROL LM: www.wrmeadows.com/#sle.
 - c. Henry Company; Aqua-Bloc WB: www.henry.com/#sle.

2.2 ACCESSORIES

- A. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
 - 1. Multi-layer internally-reinforced asphaltic panels, 1/8 inch thick, nominal, comp lying with ASTM D6506.
- B. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
 - 1. Composition: Dimpled polystyrene core; polypropylene or polyester filter fabric.
- C. Cant Strips: Premolded composition material.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- C. Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- D. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.2 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.

- D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Prepare building expansion joints at locations as indicated on drawings.
- G. Install cant strips at inside corners.

3.3 INSTALLATION

- A. Install waterproofing to specified minimum thickness in accordance with manufacturers instructions and NRCA (WM) applicable requirements.
- B. Apply primer or surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- C. At joints and cracks less than 1/2 inch in width including joints between horizontal and vertical surfaces, apply 12 inch wide strip of joint cover sheet.
- D. At joints from 1/2 inch to 1 inch in width, loop joint cover sheet down into joint between 1-1/4 inch to 1-3/4 inch, and extend sheet at least 6 inches on either side of expansion joint.
- E. Center joint cover sheet over joints, roll sheet into 1/8 inch thick coating of waterproofing material and apply second coat over sheet extending at least 6 inches beyond sheet edges.
- F. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 6 inches above horizontal surface for first ply and 6 inches at subsequent plies laid in shingle fashion.
- G. Apply extra thickness of waterproofing material at corners, intersections, and angles.
- H. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- I. Seal membrane and flashings to adjoining surfaces.

3.4 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward, and scribe and cut boards around projections, penetrations, and interruptions.
- B. Place protection board directly against drainage panel; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.

3.5 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Board insulation at cavity wall construction, perimeter foundation wall, and underside of floor slabs.
- B. Batt insulation in exterior wall construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.
- D. Foam expansion insulation.

1.2 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2020.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- E. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components 2019.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
 - 1. Report recycled content; give preference to products with the greatest recycled content.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.4 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
- B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- C. Insulation Inside Masonry Cavity Walls (CMU Backup): Polyisocyanurate board.
- D. Insulation in Metal Framed Walls: Foil-faced batt insulation.

2.2 GENERAL

- A. Recycled Content: Provide mineral wool insulation with minimum 75 percent recycled content; provide polystyrene insulation with minimum 20 percent recycled content; provide glass fiber insulation with minimum 20 percent recycled content.

- B. Thermal and acoustic insulation installed within the building interior: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 or GREENGUARD Gold certification.

2.3 RIGID FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 3. R-value; 1 inch of material at 72 degrees F: 5, minimum.
 4. Board Edges: Square.
 5. Thermal Conductivity (k factor) at 25 degrees F: 0.18.
 6. Compressive Resistance: 15 psi at vertical applications; 40 psi at foundation perimeter.
 7. Board Density: 1.3 lb/cu ft.
 8. Water Absorption, Maximum: 0.3 percent, by volume.
 9. Manufacturers:
 - a. Dow Chemical Co: www.dow.com.
 - b. Owens Corning Corp: www.owenscorning.com.
 - c. Kingspan Insulation LLC; www.trustgreenguard.com.
- B. Adhesive: Provide letters from the insulation manufacturer and vapor retarder manufacturer confirming compatibility of adhesive recommended by insulation manufacturer for applying cavity insulation.
- C. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
1. Classifications:
 - a. Type I: Faced with aluminum foil on both major surfaces of the core foam.
 - 1) Class 1 - Non-reinforced core foam.
 - 2) Compressive Strength: 16 psi, minimum.
 - 3) Thermal Resistance, R-value: At 1-1/2 inch thick; 9.0 at 75 degrees F.
 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 4. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
 5. Board Size: 48 inch by 96 inch.
 6. Manufacturers:
 - a. Carlisle Coatings & Waterproofing, Inc; R2+ Matte: www.carlisleccw.com/#sle.
 - b. Dow Chemical Company; THERMAX Brand [____]: www.dowbuildingsolutions.com/#sle.
 - c. Hunter Panels; Xci Foil (Class A): www.hunterpanels.com/#sle.
 - d. Johns Manville; AP Foil-Faced: www.jm.com/#sle.
 - e. Rmax Inc; ECOMAXci: www.rmax.com/#sle.

2.4 BATT INSULATION MATERIALS

- A. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 2. Manufacturers:

- a. Knauf Insulation; EcoBatt Insulation: www.knaufinsulation.com.
 - b. ROCKWOOL (ROXUL, Inc); AFB: www.rockwool.com.
 - c. Thermafiber, Inc; SAFB FF: www.thermafiber.com.
- B. Batt Insulation: Glass-Fiber Blanket Insulation, Reinforced-Foil Faced: ASTM C665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E 84.
 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E 84.
 3. Combustibility: Non-combustible, when tested in accordance with ASTM E 136.
 4. Manufacturers:
 - a. CertainTeed Corporation: www.certainteed.com.
 - b. Johns Manville Corporation: www.jm.com.
 - c. Knauf Insulation: www.knaufusa.com
 - d. Owens Corning Corp: www.owenscorning.com.
 5. Unfaced Batt Insulation: ASTM C 665, Type I.
- C. Sustainability Requirements: Provide glass-fiber insulation as follows:
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.
- 2.5 FOAM EXPANSION INSULATION
- A. Insulation for voids, cavities and irregularly shaped areas: Medium expansion polyurethane foam.
 - B. Type: Low pressure (less than 2 psig) closed-cell polyurethane; manufactured to ASTM E-84, Class 1 fire-rated specifications.
 - C. Characteristics: Made with renewable foaming materials, contains no formaldehyde, plumbing safe, water resistant, and safe around approved electrical insulations.
 - D. Available manufacturers include Tiger Foam Insulation, Hilti, Versi-Foam Systems, or equivalent.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Apply adhesive to back of boards:
 1. Three continuous beads per board length.
- B. Install boards horizontally on foundation perimeter.
 1. Place boards to maximize adhesive contact.

2. Install in running bond pattern.
 3. Butt edges and ends tightly to adjacent boards and to protrusions.
 - C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- 3.3 BOARD INSTALLATION AT CAVITY WALLS
- A. Adhere over outer face of block backup.
 - B. Apply the insulating board to the outer surface of the inner masonry wythe with sufficient manual pressure to assure tight joint and good contact.
 - C. Locations: At exterior cavity masonry walls and lining concrete block backup, around the building, as detailed or scheduled.
 - D. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - E. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.
 - F. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- 3.4 BOARD INSTALLATION UNDER CONCRETE SLABS
- A. Place insulation under slabs on grade after base for slab has been compacted.
 - B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
 - C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.
- 3.5 BATT INSTALLATION
- A. Install insulation in accordance with manufacturer's instructions.
 - B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
 - C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
 - D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- 3.6 PROTECTION
- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 27 10 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes fluid-applied membrane air barrier, vapor permeable.

1.2 DEFINITIONS

- A. ABAA: Air Barrier Association of America.
- B. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Supplement air barrier system components shown on the Drawings as needed to provide a complete air barrier system.
 - 1. Structurally support system to withstand positive and negative air pressures applied to the building enclosure.
 - 2. Make connection between:
 - a. Foundation and walls, including penetrations, ties and anchors.
 - b. Walls, windows, curtain walls, storefronts, louvers and doors.
 - c. Different wall assemblies, and fixed openings with those assemblies.
 - d. Wall and roof connections.
 - e. Wall and roof over unconditioned space.
 - f. Walls, floor and roof across construction, control and expansion joints.
 - g. Walls, floor and roof to utility, pipe and duct penetrations.
 - h. Floor over unconditioned space.
 - i. Junctions, abutment, and connections or overlaying with air barrier materials by different manufacturers.
 - j. Seismic and expansion joints.
 - k. All other leakage pathways in the building envelope.
 - 3. Penetrations of the air barrier and pathways of air infiltration/exfiltration must be made air-tight to have the following properties:
 - a. Air Penetrations: 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 inch water gauge (1.57 pounds per square foot) (0.02 liters per second per square meter at 75 Pascals) when tested according to ASTM E2178. Type I per ASTM E1677; test as required under Division 07.
 - b. Water Vapor Transmission: 13 perms or less when tested according to ASTM E96/E96M, Method B.

- c. Surface Burning Characteristics: Class A when tested in accordance with ASTM E84.
Flame Spread: 10, Smoke Developed: 10.

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.
- B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 1. Include details of interfaces with other materials that form part of air barrier.
 - 2. Include details of mockups.
- C. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.
- D. Qualification Data: For Applicator.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Preinstallation Conference: Conduct conference at Project site.
 - 1. Include installers of other construction connecting to air barrier, including masonry, sheathing, sealants, windows, glazed curtain walls, and door frames.
 - 2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Store rolls according to manufacturer's written instructions.
- D. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

- A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Synthetic polymer membrane.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Synthetic Polymer Membrane:
 - 1) ExoAir 230 by Tremco Sealants.
 - 2) Air Block 33 by Henry.
 - 3) Fire Resist Barritech VP by Carlisle Coatings and Waterproofing.
 - 4) Perm-A-Barrier VP or Perm-A-Barrier VP 20 LT by GCP Applied Technologies, Inc.
 - 5) Rub-R-Wall Airtight VP by Rubber Polymer Corporation, Inc.
 - 6) Air-Shield LMP by W.R. Meadows, Inc.
 2. Physical and Performance Properties:
 - a. Membrane Air Permeance: Not to exceed 0.0045 cfm/ sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
 - b. UV Resistance: Can be exposed to sunlight for minimum 180 days according to manufacturer's written instructions.
 - c. Dry Film Thickness: Minimum 30 mils over smooth, void-free substrate.

2.2 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of air barrier material.
- C. Counterflashing Strip: Modified bituminous, 40-mil thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil- thick, crosslaminated polyethylene film with release liner backing.
 1. Location: Counterflashing metal flashing within wall section.
- D. Butyl Strip: Vapor-retarding, 30 to 40-mil thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.
 1. Location: Termination at thermoplastic materials.
- E. Modified Bituminous Strip: Vapor-retarding, 40-mil thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil thick polyethylene film with release liner backing.
 1. Location: Termination with compatible membranes.
- F. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.
- G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- H. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- I. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
 1. Provide to fill gaps at penetrations and openings.
- J. Modified Bituminous Transition Strip: Vapor-retarding, 40-mil thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil thick polyethylene film with release liner backing.

1. Provide for terminations with windows, doors, curtain walls and storefront systems.
- K. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
 1. Tremco Proglaze ETA; www.tremcosealants.com
 2. Pecora Corporation's "Sil-Span"
 3. Dow Corning Corporation's "123 Silicone Seal"
 4. GE Silicones' "UltraSpan US1100"
 5. Tremco Incorporated's "Spectrem EZ Seal"
- L. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Division 7 Section "Joint Sealants."
- M. Prefabricated Flashing Accessories:
 1. Prefabricated accessories for penetrations not indicated for metal flashings, at point of penetration of substrate construction.
 2. Provide the appropriate flashing panel by Quickflash Weatherproofing Products, Inc., for all plumbing, gas, mechanical and electrical penetrations, subject to compatibility with air barrier material.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- D. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

- A. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

- A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.
- G. Seal strips and transition strips around masonry ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch wide, counterflashing strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
 - 1. Install prefabricated flashing panels as directed by manufacturer.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 AIR BARRIER MEMBRANE INSTALLATION

- A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.
- B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.
- C. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- D. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
 - 1. Vapor-Permeable Membrane Air Barrier: Minimum 40-mil dry film thickness.
- E. Apply strip and transition strip a minimum of 1 inch onto cured air membrane or strip and transition strip over cured air membrane overlapping 3 inches onto each surface according to air barrier manufacturer's written instructions.
- F. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

- G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 1. Continuity of air barrier system has been achieved with no gaps or holes.
 2. Continuous structural support of air barrier system has been provided.
 3. Site conditions for application temperature and dryness of substrates have been maintained.
 4. Maximum exposure time of materials to UV deterioration has not been exceeded.
 5. Surfaces have been primed, if applicable.
 6. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 7. Termination mastic has been applied on cut edges.
 8. Strips and transition strips have been firmly adhered to substrate.
 9. Compatible materials have been used.
 10. Transitions at changes in direction and structural support at gaps have been provided.
 11. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
 12. All penetrations have been sealed.

3.7 CLEANING AND PROTECTION

- A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.
 2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION

SECTION 07 54 16 - ADHERED TPO SHEET ROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Adhered membrane roofing system.

1.2 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.

1.3 PERFORMANCE REQUIREMENTS

- A. Work to be done by one of the two previous contractors what have worked on the roof. Nastos Construction, Inc or Simpson Unlimited.
- B. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- C. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- D. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist the design uplift pressures calculated according to building code.
 - 1. Design Uplift Pressure: As required by code and manufacturers professional engineers design calculations.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Base flashings and membrane terminations.
- C. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- D. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of meeting performance requirements.
- E. Qualification Data: For Installer and manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.
- G. Research/Evaluation Reports: For components of membrane roofing system.
- H. Maintenance Data: For roofing system to include in maintenance manuals.

- I. Warranties: Special warranties specified in this Section.
 - J. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.
 - 1. Provide qualifications of manufacturer's field representative, as required under Field Quality Control.
 - 2. Indicate procedures followed, ambient temperatures and wind velocity during application.
 - K. Professional Engineers Certification:
 - 1. System manufacturer shall supply Contractor signed and sealed ASCE 7-10 Design Velocity Pressure Calculation for Project with complimentary roof plan delineating field, perimeter and corner area dimensions.
 - 2. System manufacturer shall also provide signed and sealed written certificate from a Professional Engineer verifying that manufacturers system meets and/or exceeds the Design Velocity Pressure Calculation for all areas of the roof. NOTE: submit roof plan with exact system attachment and assembly per each area.
 - L. Emergency Response Plan:
 - 1. Any damage to the building caused by the Work, leaks or accidents must be addressed immediately by the Contractor as an emergency.
 - 2. The Contractor must respond to leaks or problems at the site during construction with a repair crew within three hours of phone notification.
 - 3. Provide a complete emergency telephone list for at least three responsible company representatives that will be on call during the course of the Project; include cell phone numbers, pager numbers and home phone numbers.
 - 4. Designate one emergency contact in writing to Owner on a weekly basis.
- 1.5 QUALITY ASSURANCE
- A. 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 warranty.
 - 1. Installer's Field Supervision: Maintain a full-time supervisor/foreman on job site during all phases of sheet roofing work and at any time roofing work is in progress; proper supervision of workmen must be maintained. A copy of the specification, pertinent details, and manufacturer's instructions to be in the possession of the supervisor/foreman and on the roof at all times.
 - B. Manufacturer Qualifications: A qualified manufacturer that has UL listing for membrane roofing system identical to that used for this Project.
 - 1. Provide a factory trained technician for participation in the pre-installation conference, weekly and final inspection of the roofing system.
 - 2. Provide a warranty upon satisfactory installation of the roofing system.
 - C. Single Source Limitations: Obtain components for membrane roofing system from a single roofing membrane manufacturer.
 - D. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.

2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.
 - E. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site. Comply with requirements for preinstallation conferences in Division 1 Section "Administrative Requirements." Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:
 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck 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 will affect 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.
- 1.6 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, 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. Protect stored liquid material from direct sunlight.
 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
 - C. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.
- 1.7 PROJECT CONDITIONS
- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- 1.8 WARRANTY
- A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period including material and labor. Failure includes roof leaks.

1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, and other components of membrane roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty signed by Installer, covering Work of this Section, including all components of membrane roofing system, for the following warranty period:
 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: Uniform, flexible sheet formed from a thermoplastic polyolefin, internally fabric or scrim reinforced and as follows:
 1. Available Manufacturers:
 - a. Tremco. (Basis-of-Design)
 - b. Firestone Building Products Company.
 - c. Carlisle SynTec Incorporated; Sure-Weld.
 - d. Versico Inc.
 2. Thickness: 80 mils, nominal.
 3. Exposed Face Color:
 - a. Color to match existing adjacent.
 4. Physical Properties:
 - a. Breaking Strength: Minimum 220 lbf; ASTM D 751, grab method.
 - b. Elongation at Break: Minimum 15 percent; ASTM D 751.
 - c. Tearing Strength: Minimum 55 lbf minimum; ASTM D 751, Procedure B.
 - d. Brittleness Point: Minus 40 deg F.
 - e. Ozone Resistance: No cracks after sample, wrapped around a 3-inch- diameter mandrel, is exposed for 166 hours to a temperature of 104 deg F and an ozone level of 100 pphm; ASTM D 1149.
 - f. Resistance to Heat Aging: 90 percent minimum retention of breaking strength, elongation at break, and tearing strength after 166 hours at 240 deg F; ASTM D 573.
 - g. Water Absorption: Less than 4 percent mass change after 166 hours' immersion at 158 deg F; ASTM D 471.
 - h. Linear Dimension Change after aging: Plus or minus 1 percent; ASTM D 1204.

2.2 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils thick, minimum, of same color as sheet membrane.
- C. Bonding Adhesive: Manufacturer's standard solvent-based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.

- D. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- E. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

2.3 INSULATION MATERIALS

- A. General: Provide preformed, roofing insulation boards that comply with requirements, selected from manufacturer's standard sizes and of thicknesses indicated.
 - 1. Provide preformed, tapered insulation boards where indicated for sloping to drain. Fabricate with a taper of 1/4-inch per 12 inches, unless otherwise indicated.
 - a. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
 - 2. Rigid Polyisocyanurate Roof Insulation:
 - a. Qualities: Polyisocyanurate board to ASTM C1289, Type II, Class I, Grade 3; rigid, closed cell type, with specially formulated organic/inorganic facers.
 - b. Available Manufacturers:
 - 1) Firestone.
 - 2) Carlisle.
 - 3) DOW Chemical Company.
 - c. Physical Properties:
 - 1) Long Term Thermal Resistance (ASTM C518): $R = 5.7$ per 1 inch of thickness.
 - 2) Board Size: Manufacturers standard.
 - 3) Nominal Product Thickness: Maximum board thickness of 2.0 inches; areas of tapered insulation is an additional thickness of insulation; roof drains tapered as indicated.
 - (a) Overall thickness as required to meet minimum R-value 30 or as required for compliance with IECC 2015 C402.2; whichever is more stringent.
 - 4) Compressive Strength (ASTM D1621): Minimum 25 psi (170kPa).
 - 5) Density (ASTM D1622): 2 pcf.
 - 6) Edges: Square.
 - 7) Dimensional Stability: Less than 2 percent linear change.
 - 8) Recycled Content: 20 percent minimum.
 - d. Provide tapered insulation as indicated on Drawings; 1/4 inch per running foot.
 - 3. Cover Board:
 - a. Project Standard: 1/2-inch DENS-DECK Roof Board by G-P Gypsum Corp. or 1/2-inch DENS-DECK Prime Roof Board by G-P Gypsum Corp.
 - b. Performance Characteristics:
 - 1) Nonstructural, glass mat-embedded, water-resistant gypsum core panels.
 - 2) UL Classified Type DGG when tested in accordance with ASTM E119.
 - 3) ASTM C1177 compliance.
 - 4) Noncombustible core per ASTM E136.
 - c. Contractor Option - Provide any of the following products with acceptance within roofing manufacturer's warranty:

1) SECUROCK by USG.

2.4 INSULATION ACCESSORIES

- A. General: Furnish roofing insulation accessories recommended by insulation manufacturer for intended use and compatible with sheet roofing material.
- B. Fasteners: Fasteners and metal or plastic plates complying with corrosion-resistance provisions of FM 4470.
 - 1. Insulation, Tapered Insulation and Cover Board:
 - a. Mechanical fasteners for securement of insulation, tapered insulation, and cover board panels to decking must be approved by the insulation manufacturer for the system specified.
 - b. The same brand fastener is to be used throughout the Work.
 - c. Number of fasteners and layout to meet requirements of ASCE 7-10 and shall be engineered by manufacturers professional engineer.
 - d. Length of fastener to be determined by the thickness of the decking and any fill, and will vary with the thickness of the insulation; fasteners must be of appropriate length to achieve a minimum of 1 inch penetration.
 - e. Acoustical Deck Locations: Fasteners not to exceed length necessary to remain concealed in acoustical cells of steel deck.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with conditions affecting performance of roofing system.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 INSTALLATION - INSULATION

- A. Lay insulation with longest dimension perpendicular to direction of membrane seams, with joints staggered and tightly butted.
- B. Install insulation to fit tightly around projections.
 - 1. Insulation joints shall be 1/4" or less in width; joints wider than 1/4" shall be filled in with appropriate insulation.
 - 2. All joints shall be staggered; stagger joints within layers at least 6"; offset joints of overlaying layers, at least 6" in both directions, from joints of previous layer.
- C. Secure insulation in place with screw and plate type fastener.
- D. Install insulation fasteners with depth-sensing screw fastening tool to prevent overdriving.
- E. Replace broken insulation with undamaged pieces, 6" by 6" minimum, properly fastened in place.

- F. Do not install more insulation than can be covered and made watertight with roofing membrane by end of same working day.
- G. Taper insulation around roof drains to prevent membrane from bridging.

3.4 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
- B. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.
- C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply solvent-based bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- E. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Minimum Seam Width: 1 1/2 inch.
 - 2. All seams to be rolled during hot air welding process.
 - 3. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 - 4. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - 5. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.

3.5 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with sheet flashing.
- D. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer Inspection Service:
 - 1. Prior to, during installation and at completion of the installation, inspections must be made by a representative of the manufacturer in order to ascertain that the roofing system has been installed according to their published specifications, standards and details.
 - 2. Keep the Architect and Owner informed as to the progress and quality of the Work as observed.
 - 3. Provide job site inspections:
 - a. Minimum of two four-hour workdays per week.
 - b. Provide a written daily report when onsite indicating the exact hours present.

4. Report to the Architect in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor's attention.
 - B. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
 1. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire roof area for potential leaks using electric field vector mapping (EFVM).
 - C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
 2. There will be no deviation from this Section, without prior written consent of the Architect and manufacturer, who will have the option of refusing to accept the installation.
 3. Confirm that the manufacturer has observed no application procedures in conflict with the specifications other than those that may have been previously reported and corrected.
 4. Repair of Deficiencies: Installations or details noted as deficient during Final Inspection must be repaired and corrected by applicator, and made ready for reinspection, within five working days.
 5. Warranty will be issued upon approval of the installation.
 - D. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.
 - E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 3.7 PROTECTING AND CLEANING
- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing 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 membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
 - C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes the following sheet metal flashing and trim:
 - 1. Manufactured reglets.
 - 2. Formed wall flashing and trim.
 - 3. Exposed trim not part of other assemblies.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:
 - 1. Identify material, thickness, weight, and finish for each item and location in Project.
 - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 - 3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
 - 4. Details of expansion-joint covers, including showing direction of expansion and contraction.
- C. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.
 - 1. Include similar samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Sheet Metal Flashing: 12 inches long. Include fasteners, closures, and other attachments.
 - 2. Trim: 12 inches long. Include fasteners and other exposed accessories.
 - 3. Accessories: Full-size Sample.

1.4 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- B. Mockups: Demonstrate aesthetic effects and set quality standards for fabrication and installation, as appropriate within wall construction mockups required under other sections.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, and roof-mounted equipment.
 - 2. Review methods and procedures related to sheet metal flashing and trim.
 - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.6 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 PRODUCTS

2.1 SHEET METALS

- A. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:
 - 1. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604.
 - b. Color: Match Architect's samples.
 - 2. Aluminum Thickness: Fabricate components not specified under other Sections or indicated on Drawings, from coil stock minimum thickness 0.040 inch.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

1. Finish: No. 2D (dull, cold rolled).
2. Through-wall: Minimum 0.0156 inch thick.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
 3. Blind Fasteners: High-strength stainless-steel rivets.
- C. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 MANUFACTURED COUNTERFLASHINGS AND REGLETS

- A. Available Manufacturers:
 1. Fry Reglet Corporation.
 - a. Heckmann Building Products Inc.
 - b. OMG Edge Metal.
 - c. Keystone Flashing Company, Inc.
 - d. Sandell Manufacturing Company, Inc.
 2. Material: Stainless steel, 0.0187 inch thick.
 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 4. Masonry Type: Provide with top flange to set in mortar joint; bent leg to resist pull-out.
 5. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and

other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

- B. 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.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

2.5 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12 foot long, sections, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch- high end dams. Fabricate from the following material:
 - 1. Stainless Steel: 0.0156 inch thick.

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 and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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 work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
 1. Coat side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
 1. Aluminum: Use aluminum or stainless-steel fasteners.
 2. Stainless Steel: Use stainless-steel fasteners.
- H. Seal joints sealant as required for watertight construction.
 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

- I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.
 - 1. Do not solder prepainted, metallic-coated steel and aluminum sheet.
 - 2. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
 - 3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.
 - J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.
- 3.3 WALL FLASHING INSTALLATION
- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- 3.4 CLEANING AND PROTECTION
- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
 - B. Clean and neutralize flux materials. Clean off excess solder and sealants.
 - C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a 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.

END OF SECTION

SECTION 07 71 00 - MANUFACTURED ROOF SPECIALTIES**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes the following manufactured roof specialties:
 - 1. Roof edge flashings.
 - 2. Prefabricated roof expansion joint covers.
 - 3. Underlayment (transition) membrane materials.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Manufacture and install manufactured roof specialties to resist thermally induced movement and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. FMG Listing: Manufacture and install copings and roof edge flashings that are listed in FMG's "Approval Guide" and approved for Windstorm Classification; Wind Zone 2 ratings. Identify materials with FMG markings.
 - 1. FM tested and approved means of fastening.
- C. Thermal Movements: Provide manufactured roof specialties that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Water Infiltration: Provide manufactured roof specialties that do not allow water infiltration to building interior.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show layouts of manufactured roof specialties, including plans and elevations. Identify factory- vs. field-assembled work. Include the following:
 - 1. Details for fastening, joining, supporting, and anchoring manufactured roof specialties including fasteners, clips, cleats, and attachments to adjoining work.
 - 2. Details for expansion and contraction.
- C. Fabrication Samples: For copings and roof edge flashings made from 12-inch lengths of full-size components including fasteners, cover joints, accessories, and attachments.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, verifying compliance of copings and roof edge flashings with performance requirements.
- E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by

dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- B. Manufacturer Qualifications: Manufacturer capable of providing engineering and field service representation during construction.
 1. Company with a minimum of ten years of continuous experience manufacturing perimeter metal systems of the type specified and capable of providing the following information.
 2. List of five other projects of similar size, including approximate date of installation and name of architect for each.
- C. Product Qualifications: Products must be accepted by roofing manufacturer within the total system warranty and listed by name on the roofing manufacturer's letterhead, as described under submittals for Section 07 54 16.

1.5 COORDINATION

- A. Coordinate installation of manufactured roof specialties with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.6 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace manufactured roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Warranty for Wind Resistance:
 1. Manufacturer shall guarantee that a standard size roof edge system, when installed per manufacturer's instructions, will not blow off, leak, or cause membrane failure, even in wind conditions up to 110 mph, or the manufacturer shall at their option repair or replace their materials.
 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

3. Basis-of-Design Product: The designs for copings and roof edge flashings are based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers specified.
4. Roofing manufacturer can supply copings and gravel stops if they comply with all product specification requirements.

2.2 EXPOSED METALS

- A. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for use and finish indicated, finished as follows:
 1. Surface: Smooth, flat finish.
 2. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Exterior Finish: Fluoropolymer 2-Coat Coating System - Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat (containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
- B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:
 1. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - a. Exterior Finish: Fluoropolymer 2-Coat Coating System - Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat (containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

2.3 CONCEALED METALS

- A. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for use and structural performance indicated, mill finished.
- B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.
- C. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, separators, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 ROOF EDGE FLASHINGS

- A. Canted Roof Edge Fascia: Manufactured, two-piece, roof edge fascia consisting of snap-on compression-clamped metal fascia cover in section lengths not exceeding 12 feet and a continuous formed galvanized steel sheet cant dam, 0.028 inch thick, minimum, with integral drip edge cleat.
 - 1. Available Products - Typical:
 - a. Safeguard NP by OMG Edge Metal.
 - b. PerformaEdge Fascia by Imetco.
 - c. System 300 Perma-Tite Fascia by Metal-Era.
 - d. Roofing Manufacturer.
 - 2. Basis-of-Design Product - Special Profiles: Refer to Drawings for custom profile.
 - a. Profile by OMG Edge Metal.
 - b. PerformaEdge (Custom) Fascia by Imetco.
 - 3. Fascia Cover: Fabricated from the following exposed metal:
 - a. Aluminum:
 - 1) Typical: Minimum 0.063 inch thick.
 - 2) Special Profiles: Minimum 0.063 inch thick.
 - 4. Fascia Cover Color: Custom color match to Metal Wall Panels; Section 07 42 13.
 - 5. Provide matching mitered and welded corner units; field verify actual constructed angles for factory-fabricated project-specific prefabricated corners.
 - 6. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.

2.6 PREFABRICATED ROOF EXPANSION JOINT COVER

- A. Basis-of-Design: Roof to Roof Expansion Joint by OMG Edge Metal.
- B. Other Acceptable Manufacturers:
 - 1. Metal Era.
 - 2. Imetco.
 - 3. Roofing manufacturer.
- C. Characteristics:
 - 1. Formed metal cap; concealed joint cover and gutter chair.
 - 2. 20 gage galvanized steel articulating cleat.
 - 3. Predrilled for shouldered fasteners 18 inches o.c. on both curbs.
 - 4. Provide with in-joint condensate seal and insulation.

2.7 UNDERLAYMENT MATERIALS

- A. 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.
 - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).

2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).
 3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:
 - a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co; Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Owens Corning; WeatherLock Metal High Temperature Underlayment.
- B. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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 work.
 1. Examine walls, roof edges, and parapets for suitable conditions for manufactured roof specialties.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install manufactured roof specialties according to manufacturer's written instructions. Anchor manufactured roof specialties securely in place and capable of resisting forces specified in performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete manufactured roof specialty systems.
 1. Install manufactured roof specialties with provisions for thermal and structural movement.
 2. Torch cutting of manufactured roof specialties is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
- C. Install manufactured roof specialties level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil-canning, buckling, or tool marks.
- D. Install manufactured roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.

- E. Expansion Provisions: Provide for thermal expansion of exposed manufactured roof specialties. Space movement joints at a maximum of 12 feet with no unplanned joints within 18 inches of corners or intersections.
- F. Fasteners: Use fasteners of type and size recommended by manufacturer but of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- G. Seal joints with elastomeric sealant as required by manufacturer of roofing specialties.

3.3 ROOF EDGE FLASHING INSTALLATION

- A. Install cleats, cant dams, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor roof edgings to resist uplift and outward forces according to performance requirements.

3.4 CLEANING AND PROTECTION

- A. Clean off excess sealants.
- B. Remove temporary protective coverings and strippable films as manufactured roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings and pieces of flashing. Maintain in a clean condition during construction.
- C. Replace manufactured roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pre-finished aluminum gutters and downspouts.
- B. Precast concrete splash pads.

1.2 RELATED REQUIREMENTS

- A. Section 07 62 00 - Sheet Metal Flashing and Trim.
- B. Section 07 71 00 - Roof Specialties.

1.3 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on prefabricated components, materials, and finishes.
- C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- D. Samples: Submit two samples, 4 inches long illustrating component design, finish, color, and configuration.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA Manual.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- B. Prevent contact with materials during storage that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Gutters and Downspouts:
 - 1. ATAS International, Inc: www.atas.com/sle.
 - 2. OMG Roofing Products: www.omgroofing.com/#sle.
 - 3. Metal-Era.
 - 4. Berger Building Products Corp.

2.2 MATERIALS

- A. Pre-Finished Aluminum Sheet: ASTM B209 (ASTM B209M), [] alloy, [] temper; 0.050 inch thick.
 - 1. Finish: Plain, shop pre-coated with PVDF (polyvinylidene fluoride) coating.
 - 2. Color: As selected by Architect from manufacturers full range.

2.3 COMPONENTS

- A. Gutters: SMACNA rectangular style profile; Figure 1-2, Style F.
- B. Downspouts: SMACNA Round profile; Figure 1-32A.
- C. Anchors and Supports: Profiled to suit gutters and downspouts.
 - 1. Anchoring Devices: In accordance with SMACNA requirements.
 - 2. Gutter Supports: Brackets sized per SMACNA Table 1-8.
 - 3. Downspout Supports: Brackets per SMACNA Figure 1-35E.
- D. Fasteners: Stainless Steel or Aluminum, with soft neoprene washers.
- E. Strainers: 15 gage stainless steel wire baskets.

2.4 ACCESSORIES

- A. Splash Pads: Precast concrete type, sizes and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.

2.5 FABRICATION

- A. Form gutters and downspouts of profiles and size indicated.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

2.6 FINISHES

- A. Fluoropolymer Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as selected by Architect from manufacturers full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

3.2 PREPARATION

- A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil.

3.3 INSTALLATION

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Support Spacing:
 - 1. Gutters:
 - a. Brackets: 36 inch o.c.
 - b. Straps: 36 inch o.c. offset 18 inches o.c. of bracket locations.

2. Downspouts: SMACNA Figure 1-35.
- C. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
 - D. Slope gutters a minimum of 1/16 inch per foot.
 - E. Provide gutter slip joints every 20 feet in length for contraction and expansion; seal joints with sealant of matching color.
 - F. Set downspouts plumb and not less than 1 inch from the wall.
 - G. Provide leaders to connect gutters on overhanging eaves to downspouts; set leaders with a slope not less than 1/16 inch per foot or more than 30 degrees below a horizontal line.
 - H. Fit leaders over the outlet tube in gutter bottom riveted to the downspout; rivet spacing shall be not more than 2 inches.
 - I. Set strainers loosely in the outlet tube opening in gutter.
 - J. Make joints between lengths of downspouts by telescoping the end of the upper lengths at least 3/4 inch into the lower length.
 - K. Set splash pans under downspouts where indicated.

END OF SECTION

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SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Roof curbs.
 - 2. Equipment supports.
 - 3. Prefabricated and engineered fixed wall ladders with roof parapet return with cage and high parapet access configurations.
 - 4. Pipe portals.

1.2 SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.
- C. 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.
- D. Delegated Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation; code compliant.

1.3 QUALITY ASSURANCE

- A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers listed in other Part 2 articles.

2.2 METAL MATERIALS

- A. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by hot-dip process and prepainted by coil-coating process to comply with ASTM A 755.
 - 1. Galvanized Steel Sheet: ASTM A 653, G90 coated.
 - 2. Exposed Finishes:
 - a. Roof Curbs, Equipment Curbs and Pipe Supports: Manufacturer's standard powder coat.
- B. Steel Shapes: ASTM A 36, hot-dip galvanized to comply with ASTM A 123, unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

- A. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches thick.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- C. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
- D. Gaskets: Manufacturer's standard tubular or fingered design of EPDM, or PVC; or flat design of foam rubber.
- E. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.4 ROOF CURBS

- A. Roof Curbs: Provide metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints, with stepped integral metal cant raised the thickness of roof insulation and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
 - 1. Available Manufacturers:
 - a. Custom Curb, Inc.
 - b. LM Curbs.
 - c. Pate Company (The).
 - d. Roof Products & Systems Corporation.
 - e. Roof Products, Inc.
 - f. ThyCurb; Div. of Thybar Corporation.
 - 2. Load Requirements: Indicated on Drawings.

3. Material: Galvanized steel sheet, 14 gage thick.
 - a. Finish: High-performance organic coating.
4. Liner: Same material as curb, of manufacturer's standard thickness and finish.
5. Factory install wood nailers at tops of curbs.
6. Factory insulate curbs with 1-1/2-inch thick, glass-fiber board insulation.
7. Curb height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer. Fabricate units to minimum height of 10 inches, unless otherwise indicated.
8. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

2.5 EQUIPMENT SUPPORTS

- A. Equipment Supports: Provide metal equipment supports, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Fabricate with welded or sealed mechanical corner joints, with stepped integral metal cant raised the thickness of roof insulation and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
 1. Available Manufacturers:
 - a. Custom Curb, Inc.
 - b. LM Curbs.
 - c. Pate Company (The).
 - d. Roof Products & Systems Corporation.
 - e. Roof Products, Inc.
 - f. ThyCurb; Div. of Thybar Corporation.
 2. Load Requirements: Indicated on Drawings.
 3. Material: Galvanized steel sheet, 14 gage thick.
 - a. Finish: High-performance organic coating.
 4. Factory-install continuous wood nailers at tops of equipment supports.
 5. Metal Counterflashing: Manufacturer's standard removable counterflashing, fabricated of same metal and finish as equipment support.
 6. Fabricate units to minimum height of 12 inches, unless otherwise indicated.
 7. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

2.6 PREFABRICATED AND ENGINEERED FIXED WALL LADDERS WITH ROOF PARAPET RETURN HIGH PARAPET ACCESS CONFIGURATIONS

- A. Manufacturers:
 1. O'Keeffe's Inc.
 2. Royalite Manufacturing Inc.
 3. ALACO.
 4. Precision Ladders.
- B. Type: Prefabricated fixed wall ladders with parapet return.
- C. Materials:
 1. Aluminum Sheet: Alloy 5005-H34 to comply with ASTM B209.
 2. Aluminum Extrusions: Alloy 6063-T6 to comply with ASTM B221.
- D. Fabrication:

1. Ladder: Side rails with minimum 1-1/8 inch round rungs that are serrated and secured with cast aluminum connectors, 4 solid rivets and minimum 9.5 mm (3/8 inch) thick brackets mounted to the walls. Top platform and side rails to extend over existing parapet / roof edge and be designed so that it is fully self-supported. Verify with existing conditions and coordinate shop drawings.
2. Provide minimum 96-inch high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.
3. Personal fall arrest system: 2-user stainless steel vertical safety system that meets ANSI Z359.16 standard with detachable cable sleeves, and top and bottom mounting brackets and cable.
4. Finish: Clear Anodic Finish: AA-M10C22A41 Mechanical finish as fabricated. Architectural Class I, clear coating 0.018 mm or thicker.

2.7 PIPE PORTALS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
 1. Custom Solution Roof and Metal Products.
 2. Pate Company.
 3. Roof Products, Inc.
 4. Thaler Metal.
- B. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless-steel snaplock swivel clamps.
- C. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless-steel snaplock swivel clamps.

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 work.
 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
 2. Verify dimensions of roof openings for roof accessories.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Install roof accessories to fit substrates and to result in watertight performance.

- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
 - 2. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.
 - D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
 - E. Roof Curb Installation: Set roof curb so top surface of roof curb is level.
 - F. Equipment Support Installation: Set equipment support so top surface of equipment support is level.
 - G. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.
- 3.3 CLEANING
- A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION

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SECTION 07 84 00 - FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.
- C. Firestopping of all joints and penetrations in non-rated assemblies.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products current edition.
- B. FM 4991 - Approval Standard for Firestop Contractors 2013.
- C. FM (AG) - FM Approval Guide current edition.
- D. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- E. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).
- F. UL (FRD) - Fire Resistance Directory Current Edition.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Installer Qualification: Submit qualification statements for installing mechanics.

1.5 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
- B. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
 - 2. Verification of minimum three years documented experience installing work of this type.
 - 3. Verification of at least five satisfactorily completed projects of comparable size and type.
 - 4. Licensed by local authorities having jurisdiction (AHJ).
 - 5. Approved by firestopping manufacturer.
- C. Installing Mechanic's Qualifications: Trained by firestopping manufacturer and able to provide evidence thereof.

1.6 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- B. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.2 FIRESTOPPING SYSTEMS

- A. F-Rated (Flame Rated) Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated as determined per ASTM E814, UL 1479 but not less than that equaling or exceeding the fire resistance rating of the construction penetrated.
- B. T-Rated (Temperature Rated) Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E814, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas; T-rated assemblies are required where specified by codes or where the following conditions exist:
 - 1. Where firestop systems protect penetrations located outside of wall cavities.
 - 2. Where firestop systems protect penetrations located outside fire resistive shaft enclosures.
 - 3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature rise rating.
 - 4. Where firestop systems protect penetrating items larger than a 4 inch diameter nominal pipe or 16 square inches in overall cross sectional area.
- C. Non-Rated Through-Penetration Requirements: At all penetrations in non-rated assemblies, fill the annular space around penetrating object with mineral wool and secure in place to resist the free passage of flame and the products of combustion.
 - 1. All unused penetrations shall be sealed closed with materials matching the material penetrated.
- D. Fire Resistive Joint Sealants: Provide joint sealants with fire resistance ratings indicated, as determined per UL 2079 or (ASTM E1399, E1966 and E2307), but not less than that equaling or exceeding the fire resistance rating of the construction in which the joint occurs.
- E. Firestopping Sealants: Comply with low-emitting requirements specified in Section 01 61 16.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labelling required by code. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency, UL system, F-rating, T-rating, and the hourly rating of the wall.
 - 4. Date of installation.
 - 5. Manufacturer's name, and product number.
 - 6. Installer's name.

3.4 FIELD QUALITY CONTROL

- A. Provide independent third-party inspection of the installed firestopping after application and prior to its concealment.
- B. Repair or replace any damaged areas of firestopping.

3.5 PROTECTION

- A. Clean adjacent surfaces of firestopping materials.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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SECTION 07 84 46 - FIRE-RESISTIVE JOINT SYSTEMS**PART 1 GENERAL****1.1 SUMMARY**

- A. This Section includes fire-resistive joint systems for the following:
 - 1. Floor-to-floor joints.
 - 2. Floor-to-wall joints.
 - 3. Head-of-wall joints.
 - 4. Wall-to-wall joints.
 - 5. Perimeter fire-resistive joint systems consisting of floor-to-wall joints between perimeter edge of fire-resistance-rated floor assemblies and exterior curtain walls.
 - 6. Smoke seals.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.
- B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities indicated as determined by UL 2079.
- C. Perimeter Fire-Resistive Joint Systems: For joints between edges of fire-resistance-rated floor assemblies and exterior curtain walls, provide systems of type and with ratings indicated below and those indicated on Drawings, as determined by NFPA 285 and UL 2079.
 - 1. UL-Listed, Perimeter Fire-Containment Systems: Integrity ratings equaling or exceeding fire-resistance ratings of floor or floor/ceiling assembly forming one side of joint.
- D. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.
- C. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.
- D. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

- A. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

- B. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
 - 1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
 - 2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:
 - a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
 - b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.
- C. VOC content not to exceed 250 g/L.

1.7 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's inspecting agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector of authorities having jurisdiction have examined each installation.

PART 2 PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

- A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.
- B. Accessories:
 - 1. Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article.
 - 2. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.
 - 3. Holding Clips: Minimum 30 gage by 1 inch wide galvanized sheet steel Z-shaped clips to support safing insulation.

2.2 SLAG-WOOL-FIBER/ROCK-WOOL-FIBER BOARD INSULATION

- A. Available Manufacturers:
 - 1. Fibrex Insulations Inc.
 - 2. Owens Corning.
 - 3. Thermafiber.
- B. Unfaced, Slag-Wool-Fiber/Rock-Wool-Fiber Board Insulation: ASTM C 612, maximum flame-spread and smoke-developed indexes of 15 and 0, respectively; passing ASTM E 136 for combustion characteristics.
 - 1. Nominal minimum density of 4 lb/cu. ft.
 - 2. Fiber Color: Regular color, unless otherwise indicated.
 - 3. Fiber Color: Darkened, where indicated.
 - 4. Uses: Where indicated and as fire safing insulation.
- C. Foil-Faced, Slag-Wool-Fiber/Rock-Wool-Fiber Board Insulation: ASTM C 612; faced on 1 side with foil-scrim or foil-scrim-polyethylene vapor retarder; with maximum flame-spread and smoke-developed indexes of 25 and 5.
 - 1. Nominal minimum density of 4 lb/cu. ft.
- D. Insulation installed within the waterproofing envelope: comply with low-emitting requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.
 - 1. Proceed with installatin only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.

2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.
- B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner may engage a qualified independent inspecting agency to inspect fire-resistive joint systems and prepare inspection reports.
- B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.
1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.
- C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.
- D. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION

SECTION 07 90 05 - JOINT SEALERS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Sealants and joint backing.
- B. Precompressed foam sealers.

1.2 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants 2017.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2018.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- D. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- E. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- F. Qualification Data: For Installer.

1.4 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.5 COORDINATION

- A. Coordinate the work with all sections referencing this section.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Gunnable and Pourable Sealants:
 - 1. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 2. Bostik Inc: www.bostik-us.com.
 - 3. Dow Corning Corporation: www.dowcorning.com.

4. Hilti, Inc: www.us.hilti.com.
 5. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 6. Pecora Corporation: www.pecora.com.
 7. Red Devil: www.reddevil.com.
 8. Tremco Global Sealants: www.tremcosealants.com.
 9. Sherwin-Williams Company: www.sherwin-williams.com.
 10. W.R. Meadows, Inc: www.wrmeadows.com.
 11. GE Silicones.
- B. Preformed Compressible Foam Sealers:
1. EMSEAL Joint Systems, Ltd: www.emseal.com.
 2. Sandell Manufacturing Company, Inc: www.sandellmfg.com.
 3. Dayton Superior Corporation: www.daytonsuperior.com.
- 2.2 MATERIALS, GENERAL
- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Prohibit Methylene chloride and perchloroethylene in sealants.
- C. Colors of Exposed Joint Sealants:
1. As selected by Architect from manufacturer's full range.
 2. Allow custom colors for masonry joints.
 3. Allow for four custom exterior custom colors including masonry joints.
- 2.3 SEALANTS
- A. Type LS-1 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
1. Color: Standard colors matching finished surfaces.
- B. Type AS-1 - Acoustical Sealant for Concealed Locations:
1. Composition: Permanently tacky non-hardening butyl sealant.
 2. Applications: Use for concealed locations only:
 - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.
 - b. Sealant between acoustical ceiling perimeter track and wall.
- C. Single-Component Neutral- and Basic-Curing Silicone Sealant ES-1:
1. Products:
 - a. Dow Corning Corporation; 790.
 - b. Tremco; Spectrem 1 (Basic).
 - c. GE Silicones; SilPruf SCS2000.
 - d. Pecora Corporation; 864.
 - e. Polymeric Systems Inc.; PSI-641.
 - f. Sonneborn, Division of ChemRex Inc.; Omniseal.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 100/50.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and brick.

6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
 - D. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant ES-2:
 1. Products:
 - a. Pecora Corporation; 898.
 - b. Tremco; Tremsil 600 White.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 25.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: color anodic aluminum aluminum coated with a high-performance coating galvanized steel and ceramic tile.
 - E. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant ES-3:
 1. Products:
 - a. Dow Corning Corporation; 786 Mildew Resistant.
 - b. GE Silicones; Sanitary SCS1700.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 25.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: color anodic aluminum, aluminum coated with a high-performance coating, and ceramic tile.
 - F. Multicomponent Nonsag Urethane Sealant ES-4:
 1. Products:
 - a. Pecora Corporation; Dynatrol II.
 - b. Tremco; Dymeric 240/240FC.
 - c. Tremco; Vulkem 921.
 2. Type and Grade: M (multicomponent) and NS (nonsag).
 3. Class: 50.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, brick, ceramic tile, and wood.
 - G. Multicomponent Nonsag Urethane Sealant ES-5:
 1. Products:
 - a. Sonneborn, Division of ChemRex Inc.; NP 2.
 - b. Tremco; Vulkem 227.
 2. Type and Grade: M (multicomponent) and NS (nonsag).
 3. Class: 25.
 4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
 5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
 6. Use O Joint Substrates: Color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and brick.
- ## 2.4 PREFORMED JOINT SEALERS
- A. Type PS-1 - Exterior Expansion Joint Sealer: Precompressed foam sealer; factory-applied and cured silicone facing.

1. Face color: Coordinated with veneer; to be selected by Architect.
2. Size as required to provide weathertight seal when installed.
3. Provide product recommended by manufacturer for traffic-bearing use.
4. Product: Colorseal manufactured by EMSEAL.
5. Applications: Use for:
 - a. Exterior wall expansion joints.

2.5 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Secondary Joint Backing: Precompressed foam sealer; urethane with water-repellent.
 1. Size as required to provide weathertight seal when installed.
 2. Product: Backerseal manufactured by EMSEAL.
- E. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.

3.4 CLEANING

- A. Clean adjacent soiled surfaces.

3.5 PROTECTION

- A. Protect sealants until cured.

3.6 SCHEDULE

- A. Joint-Sealant Application JS-1: Exterior vertical and horizontal nontraffic construction joints in cast-in-place concrete.
 - 1. Joint Sealant: ES-1 or ES-4.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- B. Joint-Sealant Application JS-2: Exterior horizontal traffic isolation and contraction joints in cast-in-place concrete slabs.
 - 1. Joint Sealant: ES-5.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- C. Joint-Sealant Application JS-3: Exterior vertical control and expansion joints in unit masonry.
 - 1. Joint Sealant: ES-1 or ES-4.
 - 2. Joint-Sealant Color: Maximum of two custom colors.
- D. Joint-Sealant Application JS-5: Exterior vertical joints between different materials listed above.
 - 1. Joint Sealant: ES-1 or ES-4.
 - 2. Joint-Sealant Color: Maximum of two custom colors.
- E. Joint-Sealant Application JS-6: Exterior perimeter joints between masonry and frames of doors, windows, and louvers.
 - 1. Joint Sealant: ES-1 or ES-4.
 - 2. Joint-Sealant Color: Maximum of two custom colors.
- F. Joint-Sealant Application JS-7: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
 - 1. Joint Sealant: ES-4.
 - 2. Joint-Sealant Color: To be field painted.
- G. Joint-Sealant Application JS-8: Interior perimeter joints of exterior openings.
 - 1. Joint Sealant: ES-2 or ES-3.
 - 2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- H. Joint-Sealant Application JS-9: Interior ceramic tile expansion, control, contraction, and isolation joints in horizontal traffic surfaces.
 - 1. Joint Sealant: ES-2 or ES-3.
 - 2. Joint-Sealant Color: Maximum of two custom colors.
- I. Joint-Sealant Application JS-10: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
 - 1. Joint Sealant: ES-2 or ES-3.
 - 2. Joint-Sealant Color: White.
- J. Joint-Sealant Application JS-11: Vertical joints on exposed surfaces of interior unit masonry and concrete walls.
 - 1. Joint Sealant: ES-4.
 - 2. Joint-Sealant Color: To be field painted.
- K. Joint-Sealant Application JS-12: Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
 - 1. Joint Sealant: LS-1.
 - 2. Joint-Sealant Color: To be field painted.
- L. Joint-Sealant Application JS-13: Preformed exterior expansion joints without cover.
 - 1. Location: Where designated on drawings.

2. Joint Sealant: PS-1, where indicated to produce a finished color.

END OF SECTION

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

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.

1.2 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.

1.3 REFERENCE STANDARDS

- A. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2011.
- B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
- C. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2011.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2020.
- F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.
- I. ITS (DIR) - Directory of Listed Products current edition.
- J. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.
- K. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.
- L. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
- M. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.
- N. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- O. UL (DIR) - Online Certifications Directory Current Edition.
- P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
 - 1. Submit door and frame schedule using reference designations indicated on Drawings. Include opening size(s), handing of doors, details of each frame type, elevations of door design types, location, hardware set numbers, details of splice connections, fire label requirements, temperature rise requirements, grout guard detail, hardware mounting locations, glass moldings, welding details, internal reinforcing and anchor details.
 - 2. As part of the shop drawing submittal, provide copies of the following:
 - a. ANSI/A250.11-2012 - Recommended Erection Instructions for Steel Frames
 - b. HMMA-820, TN01-03 - Grouting Hollow Metal Frames
 - c. HMMA-840, TN01-07 - Painting Hollow Metal Products
 - d. HMMA-810, TN01-03 - Defining Undercuts
- D. Manufacturer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Supplier Qualifications:
 - 1. Supplier must maintain at the location which will be managing the project, a credentialed Architectural Hardware Consultant (AHC) or Certified Door Consultant (CDC) as a full time employee, and member in good standing of DHI - Door Security + Safety Professionals.
 - 2. Architectural Hardware Consultant (AHC) or Certified Door Consultant (CDC) to supervise other individuals employed by the supplier who work on the project and be available throughout the Project to meet with the Contractor, Architect or Owner as needed.
 - 3. Supplier must be experienced and have completed projects with material, design and scope similar to that specified for this project. If requested by the Owner or Architect, submit a list of projects completed in the last five years with the project name, location, owner, architect and contractor.
 - 4. Supplier must maintain an office and warehouse complete with a hollow metal inventory within a 100 mile radius of the jobsite. Supplier to further have a qualified field service staff available to service the Project.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store doors vertically in a dry area, under proper cover. Place the units on 4" high wood sills on floors in a manner that will prevent rust and damage. Avoid storage in non-vented plastic or canvas shelters, which create a humidity chamber and promote rusting. If the door becomes wet, or moisture appears, remove protective wrapping immediately. Provide a 4" space between

the doors to permit air circulation. Proper storage is required to meet the requirements of ANSI/SDI A250.10 and HMMA 840.

B. Storage of Frames:

1. Store frames in an upright position with heads uppermost under cover on 4" wood sills on floors in a manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters, which create a humidity chamber and promote rusting. Store assembled frames in a vertical position, five units maximum in a stack. Provide a 2" space between frames to permit air circulation.
2. Store all hollow metal products in a manner to prevent exposure to adverse environmental elements and maintain the requirements of ANSI/SDI A250.10 and HMMA 840.
3. Sand, touch up and clean prime painted surfaces prior to finish painting in accordance with the manufacturer's instructions. Zinc base primer is to be used at all galvanized doors and frames.

1.7 COORDINATION

- A. Coordinate Work with other sections involving manufacture or fabrication of internal cutouts and reinforcement for door hardware and electrified items.
- B. Coordinate hardware mounting heights as specified under Section 08 71 00.
- C. Coordinate door undercuts with architect's details and specified hardware under Section 08 71 00. Interior doors to be 3/8" undercut unless otherwise indicated.
- D. Factory prep hollow metal frames to receive door contacts. Refer to security drawings for details, diagrams and locations.
- E. The Contractor shall field verify existing door opening conditions where existing doors or frames are to remain or be replaced in part, for coordination with the specified hardware and notify the Architect of conflicts prior to proceeding. Failure to notify the Architect of conflicts that result in additional work or material is the responsibility of the Contractor, with no cost to the Owner.
- F. Field dimensions need to be verified and approved prior to fabrication.
- G. The supplier shall be responsible for proper coordination, templating, dimensions and all details required for doors, frames and hardware application.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Assa Abloy Ceko, Curries, or Fleming: www.assaabloydss.com.
- B. Mesker, dormakaba Group: www.meskeropeningsgroup.com.
- C. Metal Products, Inc.: www.metalproductsinc.com.
- D. Republic Doors, an Allegion brand: www.republicdoor.com.
- E. Steelcraft: www.steelcraft.com.
- F. Pioneer Industries, an Assa Abloy company; www.pioneerindustries.com.

2.2 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM

- A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Recycled Content: Provide steel and aluminum with minimum 25 percent post-consumer recycled content.
 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 4. Door Edge Profile: Manufacturers standard for application indicated.
 5. Typical Door Face Sheets: Flush.
 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
 7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
 9. Finish: Factory primed, for field finishing.
- B. Energy Efficient Exterior Openings: Comply with minimum thermal ratings, based on ASTM C1363. Openings to be fabricated and tested as fully operable, thermal insulating door and frame assemblies.
1. Thermal Performance (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with NFRC 102 and/or ASTM C1363 and meet or exceed the following requirements:
 - a. Door Assembly Operable U-Factor and R-Value Ratings: U-Factor 0.374, R-Value 2.53, including insulated door and thermal-break frame.
 2. Air Infiltration (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with NFRC 400 and/or ASTM E283 to meet or exceed the following requirements:
 - a. Rate of leakage of the door assembly shall not exceed 0.1 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).
 3. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound or thermally-rated must comply with the requirements specified for exterior doors and for sound or thermally-rated doors; where two requirements conflict, comply with the most stringent.
- 2.3 HOLLOW METAL DOORS
- A. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
 2. Door Core Material: Polyurethane.

- a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
 3. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
 4. Weatherstripping: Refer to Section 08 71 00.
 5. Close to and bottom edges with galvanized, inverted steel channels; seal joints in top edges of doors against water penetration.
- B. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
 2. Door Thickness: 1-3/4 inch, nominal.
- C. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - a. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
 - b. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - c. Attach fire rating label to each fire rated unit.
- 2.4 HOLLOW METAL FRAMES
- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Thermal Break Exterior Door Frames: kerf type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
 2. Thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400.
 3. Fabricate with 1/16-inch positive thermal break and integral vinyl weatherstripping, matching tested assembly.
 4. Fabricate with mitered corners; profile as indicated on drawings.
 5. Frame Metal Thickness: 12 gage, 0.093 inch, minimum.
- C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
- D. Door Frames, Fire-Rated: Full profile/continuously welded type.
1. Fire Rating: Same as door, labeled.

- E. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- F. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inch high to fill opening without cutting masonry units.
- G. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
- H. Mullions and Transom Bars: Join to adjacent members by welding.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 ACCESSORIES

- A. Glazing: As specified in Section 08 80 00, factory installed.
- B. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
- C. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.
- E. Ceiling Struts: Minimum 1/4 inch thick by 1 inch wide steel.

2.7 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

2.8 INSECT SCREEN FOR KITCHEN DOOR

- A. Provide insect screens as indicated. Design door framing and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches.
- B. Screen Frames: Fabricate frames of tubular-shaped, extruded- or formed-aluminum members of 0.050-inch-minimum wall thickness, with mitered or coped joints and concealed mechanical fasteners. Finish frames to match door. Provide removable PVC spline-anchor concealing edge of screen frame.
- C. Stainless Steel Wire Fabric: 18-by-16 mesh of 0.011 inch diameter, non-magnetic stainless steel wire, Type 304 or 316 complying with FS RR-W-365, Type VI.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.2 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Install door silencers in frames before grouting.
- E. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
 - 1. Hollow Metal Frames to receive grouting shall comply with ANSI/SDI Standard A250.8, paragraph 4.2.2., and HMMA 820 TN101, Grouting Hollow Metal Frames.
 - 2. Contractor to provide a metal mortar box at all hollow metal frames in masonry walls to receive electrical hardware and security components. Grout only the vertical jambs after mortar boxes and conduit are in place and field caulked. Do not grout frame heads.
 - 3. Provide and install temporary bottom and intermediate wood spreaders to maintain proper width and avoid bowing of jambs or deforming of frame members. Reference ANSI.A250.11.
- F. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
- G. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
- H. Install door hardware as specified in Section 08 71 00.
- I. Coordinate installation of glazing; install frames with removable glazing stops located on secure side of opening.
- J. Coordinate installation of electrical connections to electrical hardware items.
- K. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
- L. Touch up damaged factory finishes.
- M. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors according to NFPA 105.

3.3 TOLERANCES

- A. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
- B. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
- C. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
- D. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

3.4 ADJUSTING

- A. Adjust for smooth and balanced door movement.
- B. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- C. Remove grout and other bonding material from hollow metal work immediately after installation.
- D. 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.
- E. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- F. Fire Door Assembly Inspection and Testing: Upon completion of the installation, provide functional testing and inspection of each fire door assembly on the project to confirm proper operation and that it meets all criteria of a fire door assembly as per NFPA 80, 5.2 - Inspection and Testing, 2013 edition. Inspections shall be performed by individuals with knowledge and understanding of the operating components of the door being subjected to testing and who are certified by Intertek as a Fire Door Assembly Inspector (FDAI) or a credentialed Architectural Hardware Consultant (AHC). A written report using reporting forms provided by the Door and Hardware Institute shall be maintained and transmitted to the Owner, Architect, Contractor and made available to the Authority Having Jurisdiction (AHJ). The report shall list each fire door throughout the project, and include door number, location, hardware set used and summary of deficiencies.
 - 1. Schedule fire door assembly inspection within 90 days of Substantial Completion of the Project. Coordinate inspection with the Contractor and Owner.
 - 2. Contractor shall correct all deficiencies and schedule a re-inspection of fire door assemblies which were noted as deficient on the inspection report. All deficiencies must be repaired without delay.
 - 3. Inspector shall re-inspect fire door assemblies after repairs are made.
 - 4. Additional re-inspections which are required due to incomplete repairs will be performed by the inspector at the expense of the Contractor.

3.5 PROTECTION

- A. Provide protective measures required throughout the construction period to ensure that door and frame units will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION

SECTION 08 14 16 - FLUSH WOOD DOORS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Flush wood doors; flush and flush glazed configuration; fire rated, non-rated, and acoustical.

1.2 RELATED REQUIREMENTS

- A. Section 08 80 00 - Glazing.
- B. Section 09 93 00 - Staining and Transparent Finishing: Field finishing of doors.

1.3 REFERENCE STANDARDS

- A. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- B. ASTM E413 - Classification for Rating Sound Insulation 2016.
- C. AWI/AWMAC (QSI) - Architectural Woodwork Quality Standards Illustrated; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2005, 8th Ed., Version 2.0.
- D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
- E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Specimen warranty.
- D. Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- E. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria, identify cutouts for glazing and louvers.
 - 1. Shop Drawings: Submit door and frame schedule using reference designations indicated on Drawings. Include opening size(s), handing of doors, details of each frame type, elevations of door design types, location, hardware group numbers, fire label requirements, including fire rating time duration, maximum temperature rise requirements, hardware mounting locations, glass beads/moldings, glass kits, internal blocking, vertical edge details, top and bottom rail details, undercuts, beveling and other pertinent data.
 - 2. As part of the Shop Drawing submittal, provide copy of WDMA J1, Job Site Information, "How to store, handle, finish, install and maintain wood doors."
 - 3. Provide door construction details/drawings of vertical edges, top rail and SWE details for all doors.
 - 4. Indicate location of cutouts for hardware and blocking to ensure doors are properly prepared and coordinated to receive hardware.
- F. Samples: Submit two samples of door veneer, 12 x 12 inch in size illustrating wood grain, stain color, and sheen.
- G. Warranty, executed in Owner's name.

1.5 QUALITY ASSURANCE

- A. Forest Certification: Provide wood products made from forests certified by an FSC-accredited certification body. All non-FSC wood in assemblies with FSC-certified wood shall meet the FSC Controlled Wood (CW) criteria.
- B. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated.
 - 1. Provide metal labels permanently affixed to each fire door at an authorized and licensed facility as evidence of compliance with procedures of the labeling agency.
 - 2. No field modifications can be made to the fire door assembly that would void the label. Field modifications to a fire door must be in accordance with NFPA80. Work must be done by a licensed labeling service approved by the manufacturer.
 - 3. Labels are not to be removed, defaced or made illegible while the door is in service per NFPA 80. Fire labels are not to be painted or pre-finished.
 - 4. Fire doors with continuous hinges to have the physical label located on the top rail of the door.
- C. Supplier Qualifications:
 - 1. Supplier must maintain at the location which will be managing the project, a credentialed Architectural Hardware Consultant (AHC) or Certified Door Consultant (CDC) as a full time employee and member in good standing of DHI - Door Security + Safety Professionals.
 - 2. The Architectural Hardware Consultant (AHC) or Certified Door Consultant (CDC) shall supervise other individuals employed by the Wood Door Supplier who work on the project and be available throughout the project to meet with the Contractor, Architect or Owner as needed.
 - 3. Supplier must be experienced and have completed projects with material, design and scope similar to that specified for this project. If requested by the Owner or Architect, submit a list of projects completed in the last five (5) years with the project name, location, Owner, Architect and Contractor.
 - 4. Supplier must maintain an office and warehouse complete with a wood door inventory within a 100 mile radius of the jobsite. Supplier must have a qualified field service staff available to service the Project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Provide protective measures throughout the construction period to safeguard doors from damage or deterioration from the time of acceptance.
- D. Store and protect doors in accordance with manufacturer's recommendations and Section J-1 of WDMA I.S. 1A-13 - "How to Store, Handle, Finish, Install and Maintain Wood Doors"
 - 1. Store doors flat and off the floor on a level surface in a dry, well-ventilated building. Do not store on edge. Protect doors from dirt, water and abuse and allow for air circulation.
 - 2. Protect all doors from exposure to direct sunlight and artificial light after delivery.
 - 3. Do not subject interior doors to extremes of either heat or humidity. HVAC systems must be operational and balanced, providing a temperature range of 50 to 80 degrees Fahrenheit and 30% to 60% relative humidity.
 - 4. When handling doors, lift and carry when moving. Do not drag across other doors or surfaces. Handle with clean, dry hands or while wearing clean dry gloves.

- E. Manufacturer shall mark each door on the top rail and top hinge pocket with the door opening number. In addition, mark the top rail with manufacture's name, factory order number, and other additional markings to properly identify the door.

1.7 PROJECT CONDITIONS

- A. Coordinate the work with door opening construction, door frame and door hardware installation.

1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eggers Industries/VT Industries: www.eggersindustries.com.
- B. Lambton Doors: www.lambtondoors.com.
- C. Masonite Architectural Aspiro Series; Marshfield-Algoma legacy brand: <https://architectural.masonite.com/products/aspiro-series>.
- D. Oshkosh Architectural Door Company: www.oshkoshdoor.com.

2.2 DOORS

- A. Doors: Refer to drawings for locations and additional requirements.
 - 1. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty / Custom
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 - a. Validate the Smoke and Draft Control (" S") Label for hardware sets that include Category H smoke and draft control seals.
 - 3. Sound-Rated Doors: Minimum STC of 42 or better, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
 - a. Provide doors specifically designed for sound transmission control with a high density core and damping.
 - b. Refer to hardware specification for required hardware items.
 - 4. Wood veneer facing for field transparent finish as indicated on drawings.

2.3 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type structural composite lumber core (SCLC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
- C. Sound-Rated Doors: Equivalent to type, with particleboard core (PC) construction as required to achieve STC rating specified; plies and faces as indicated above.

2.4 DOOR FACINGS

1. MDO, Hardboard, or MDF
 - a. Hardboard Faces: ANSI A135.4, Class 1 or Class 2
 - b. MDF Faces: ANSI A208.2, Grade 150 or Grade 160
2. Exposed Vertical and Top Edges: Any closed-grain hardwood.
 - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.

2.5 ACCESSORIES

- A. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

2.6 DOOR CONSTRUCTION

- A. Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.
- B. Cores Constructed with Bonded Stiles and Rails:
 1. Provide solid blocks at lock edge for hardware reinforcement.
 2. Provide solid blocking for other through bolted hardware.
- C. Fit door edge trim to edge of stiles after applying veneer facing.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.2 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.3 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.
- C. Fire Door Assembly Inspection and Testing: Upon completion of the installation, provide functional testing and inspection of each fire door assembly on the project to confirm proper operation and that it meets all criteria of a fire door assembly as per NFPA 80, 5.2 - Inspection and Testing 2013 edition. Inspections shall be performed by individuals with knowledge and

understanding of the operating components of the door being subjected to testing and who are certified by Intertek as a Fire Door Assembly Inspector (FDAI) or a credentialed Architectural Hardware Consultant (AHC). A written report using reporting forms provided by the Door and Hardware Institute shall be maintained and transmitted to the Owner, Contractor, Architect and made available to the Authority Having Jurisdiction (AHJ). The report shall list each fire door throughout the project, and include each door number, location, hardware set used and summary of deficiencies.

1. Schedule fire door assembly inspection within 90 days of Substantial Completion of the Project. Coordinate inspection with the Contractor and Owner
2. Contractor shall correct all deficiencies and schedule a re-inspection of fire door assemblies which were noted as deficient on the inspection report. All deficiencies must be repaired without delay.
3. Inspector shall re-inspect fire door assemblies after repairs are made.
4. Additional re-inspections which are required due to incomplete repairs will be performed by the inspector at the expense of the Contractor.

3.4 PROTECTION

- A. Provide protective measures required throughout the construction period to ensure that doors will be without damage or deterioration at time of acceptance.

END OF SECTION

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SECTION 08 31 00 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Access door and frame units, fire-rated, in wall locations.

1.2 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products current edition.
- B. UL (FRD) - Fire Resistance Directory Current Edition.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Babcock-Davis.
 - 1. Non-Rated: Cierra BNT Series.
 - 2. Rated: Cierra BIT Series.
- B. Karp Associates, Inc.
 - 1. Non-Rated: DSC-214M Series.
 - 2. Rated: KRP Series.
- C. Milcor Inc.:
 - 1. Non-Rated: Style M or DW.
 - 2. Rated: Style UFR or NIFR.
- D. Nystrom, Inc.
 - 1. Non-Rated: NT Series.
 - 2. Rated: Cierra I Series.
- E. Williams Bros. Corporation of America:
 - 1. Non-Rated: WB-GP or WB-DW Series.
 - 2. Rated: WB-FR Premium or WB-FR Standard with Drywall Bead.

2.2 ACCESS DOORS AND PANELS

- A. All Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
- B. Units in Fire Rated Assemblies: Fire rating equivalent to the fire rated assembly in which they are to be installed.
 - 1. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.

2.3 ACCESS DOOR UNITS - WALLS AND CEILINGS

- A. Door and Frame Units: Formed steel.

1. Door: Minimum 16 gage thick sheet metal, set flush with exposed face flange of frame.
 2. Frame: Minimum 16 gage thick sheet metal with 1 inch wide, surface-mounted trim.
 3. Hinges: Concealed pivot rod.
 4. Lock: Provide door panel with cylinder keyed to building Best Lock masterkey program.
 5. Steel Finish: Factory primed for field painting.
- B. Fire-Rated, Insulated, Flush Access Doors and Frames with Exposed Trim: Formed steel.
1. Fire-Resistance Rating: Not less than that of adjacent construction.
 2. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
 3. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 20 gage.
 4. Frame: Minimum 16 gage thick sheet metal with 1-inch wide, surface-mounted trim.
 5. Hinges: Concealed-pin type.
 6. Automatic Closer: Spring type.
 7. Lock: Self-latching device with cylinder keyed to building Best Lock masterkey program.
 8. Steel Finish: Factory primed for field painting.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 62 70 - TUBULAR SKYLIGHTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tubular daylighting device, consisting of roof dome, reflective tube, and diffuser assembly; configuration as indicated on the drawings.
- B. Accessories.

1.2 REFERENCES

- A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM A 463 - Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process.
- C. ASTM A 653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), by the Hot Dip Process.
- D. ASTM E 283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- E. ASTM E 308 - Standard Practice for Computing the Colors of Objects by Using the CIE System.
- F. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls and Doors.
- G. ASTM E 547 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain walls by Cyclic Air Pressure Difference.
- H. ASTM D 635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position.
- I. ASTM D-1929 - Test Method for Ignition Properties of Plastics.
- J. UL 181 - Factory Made Air Ducts and Air Connectors.
- K. UL 790 - Standard for Tests for Fire Resistance of Roof Covering Materials.
- L. ICBO/ICC AC-16 - Acceptance Criteria for Plastic Skylights.

1.3 PERFORMANCE REQUIREMENTS

- A. Completed tubular daylighting device assemblies shall be capable of meeting the following performance requirements:
 - 1. Air Infiltration Test: Air infiltration will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.
 - 2. Water Resistance Test: No uncontrolled water leakage at 10.5 psf pressure differential with water rate of 5 gallons/hour/sf when tested in accordance with ASTM E 547.
 - 3. Uniform Load Test:
 - a. No breakage, permanent damage to fasteners, hardware parts, or damage to make daylighting system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf or Negative Load of 70 psf.
 - b. All units shall be tested with a safety factor of 3 for positive pressure and 2 for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.
 - 4. Fire Testing:
 - a. When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the 2006 International Building Code.

- b. Self-Ignition Temperature - Greater than 650 degrees F Per: U.B.C. Standard 26-6. See ASTM D-1929.
 - c. Smoke Density - Rating no greater than 450 Per U.B.C. 8-1 (See ASTM Standard E 84) in way intended for use. Classification C.
 - d. Rate of Burn and/or Extent - Maximum Burning Rate: 2.5 inches/min Classification CC-2: U.B.C. Standard 26-7. See ASTM D 635.
 - e. Rate of Burn and/or Extent - Maximum Burn Extent: 1 inch (25 mm) Classification CC-1: U.B.C. Standard 26-7. See ASTM D 635.
5. Thermal Performance:
- a. U-Factor: 0.47.
 - b. R-Value: Minimum of 2.0.
 - c. SHGC: 0.20.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings. Submit shop drawings showing layout, profiles and product components, including anchorage, flashings and accessories.
- D. Verification Samples: As requested by Architect.
- E. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

- A. Daylighting Device: Manufacturer's standard warranty for 10 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design: Solatube International, Inc: www.solatube.com
- B. Subject to compliance with specifications, the following manufactures may be used:
 - 1. Elite Solar Lighting
 - 2. Tubular-Skylight

3. Trulite

2.2 TUBULAR DAYLIGHTING DEVICES

- A. Tubular Daylighting Devices General : Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICBO/ICC AC-16.
- B. Bent and straight runs as indicated on the drawings.
- C. Project Standard: Solatube Model 750 DS-C Penetrating Ceiling, 21 inch Daylighting System:
1. Roof Dome Assembly (Type DAI): Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
 - a. Outer Dome Glazing: 0.125 inch minimum thickness injection molded acrylic classified as CC2 material; UV inhibited, impact modified acrylic blend.
 - b. Inner Dome Glazing: 0.115 inch minimum thickness acrylic classified as CC2 material.
 2. Roof Flashing Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.
 - a. Base Style: Type FC, Curb cap, to cover curb.
 - b. Curb: Type C20, Metal Insulated curb, 26 inch x 26 inch x 20 inch.
 3. Tube Ring: Attached to top of base section; 0.090 inch nominal thickness injection molded high impact PVC; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing.
 4. Dome Seal: Adhesive backed weatherstrip 0.63 inch tall by 0.28 inch.
 5. Reflective Tubes: Aluminum sheet, thickness 0.018 inch.
 - a. Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface. Specular reflectance for visible spectrum greater than 99 percent. Total solar spectrum reflectance less than 93 percent.
 - b. Top Tube Angle Adapter and Bottom Top Tube Angle Adapter Kit:
 - 1) Reflective 30 degree adjustable top and bottom angle adapters (one each), 16 inches long.
 - c. Reflective 90 degree Adjustable tube: As required by location and design.
 6. Diffuser Assemblies for Tubes Penetrating Ceilings: Ceiling mounted box transitioning from round tube to square ceiling assembly, supporting light transmitting surface at bottom termination of tube; 23.8 inches by 23.8 inches square frame to fit standard suspended ceiling grids or hard ceilings.
 - a. Round to square transition box made of opaque polymeric material, classified as CC2, Class C, 0.110 inch thick.
 - b. Natural Effect Lens made of acrylic, classified as CC2, Class C, 0.060 inch thick, with open cell foam seal to minimize condensation and bug, dirt, and air-infiltration per ASTM E283.
 - c. Lens: Optiview Type L1 lens design to maximize light output and diffusion with extruded aluminum frame. Visible Light Transmission shall be greater than 90 percent at 0.100 inches thick. Classified as CC2.
 7. Accessories:
 - a. Wire Suspension Kit: Type E, Use the wire suspension kit when additional bracing to the structure is required.
 - b. Dome edge protection band curb cap.

2.3 ACCESSORIES

- A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
- B. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.
- C. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.
 - 1. Interior wet-applied sealants and sealant primers: Comply with low-emitting requirements in Division 01 Section "Sustainable Design Requirements - LEED."

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. After installation of first unit, field test to determine adequacy of installation. Conduct water test in presence of Owner, Architect, or Contractor, or their designated representative. Correct if needed before proceeding with installation of subsequent units.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 08 71 00 – DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Everything necessary for and incidental to the execution and completion of all door hardware work, as indicated on the drawings and specified herein.
- B. Extent of door hardware is shown on the drawings and in the schedules. Door hardware includes all items known commercially as "Builders Hardware" required for swinging, sliding and bi-folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.

1.2 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Door and Frames.
- B. Section 08 14 16 - Flush Wood Doors.
- C. Section 08 33 16 - Overhead Coiling Doors.
- D. Section 08 43 13 - Aluminum-Framed Storefronts.
- E. Division 26 for line- and low-voltage wiring and power requirements.
- F. Division 28 for provisions for electronic security system and connections to building fire alarm system.

1.3 REFERENCES

- A. The publications listed below, including the amendments, addenda and designated changes, form a part of this specification to the extent referenced.
 - 1. Federal Specifications (FS): FF-H-111C-74 Hardware, Builders Shelf and Miscellaneous.
 - 2. National Fire Protection Association (NFPA):
 - a. Standard 70, National Electric Code.
 - b. Standard 80, Fire Doors and Windows.
 - c. Standard 101, Life Safety Code.
 - d. Standard 252, Standard Methods of Fire Tests of Door Assemblies.
 - 3. American National Standards Institute (ANSI):
 - a. A156.6, Architectural Door Trim.
 - b. A156.18, Materials and Finishes.
 - 4. International Building Code (IBC).
 - 5. Americans with Disabilities Act (ADA): Standards for Accessible Design.
 - 6. Door and Hardware Institute (DHI):
 - a. Keying Systems and Terminology.
 - b. Abbreviations and Symbols.
 - c. Recommended Locations for Builder's Hardware for Custom Steel Doors and Frames.
 - 7. Underwriters Laboratories, Inc. (UL): UL-BMD, Building Materials Directory.

1.4 SUBMITTALS

- A. Supplier's Hardware Schedule: Submit a finish hardware schedule in accordance with Division 01 in the manner and format prescribed and used herein, complying with the actual construction progress. Hardware schedules are intended for coordination of the work. Review and acceptance by the Architect or Owner does not relieve the Contractor of his exclusive responsibility to fulfill the requirements as shown and specified.

1. Hardware Schedule Content: Based on hardware indicated, organize hardware schedule into Sets or sets showing complete designations of every item required for each door opening. Schedule shall be vertical layout similar to the format used herein. Lines shall be double spaced with pages numbered and dated.
 - a. For doors of different sizes or where hinges, locks or closers are different, a separate heading shall be used. No labeled openings shall be combined with non-labeled openings. Horizontal hardware schedules are not acceptable. Include the following:
 - 1) Number, location, hand, fire rating, size and material of each door opening (hands and swings to be determined in relation to key side of opening).
 - 2) Type, style, function, size, finish and quantity of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastening requirements.
 - 5) Explanation of abbreviations used (use nomenclature consistent with DHI's "Abbreviations and Symbols" wherever possible).
 - 6) Special mounting locations and instructions.
 - b. Combined submittals are not acceptable. Do not combine hardware schedules with door and frame shop drawings.
 2. Hardware Schedule Index: Furnish an index cross referencing Contract Document door number and Hardware Set, and supplier's hardware set.
 3. Schedules not adhering to these parameters will not be reviewed.
- B. Product Data: Submit copies of manufacturers' specifications, maintenance and keying manuals, and installation instructions for each item of door hardware.
1. Include photographs, catalog cuts, marked templates and other data as may be required to show compliance with these Specifications.
- C. Samples: Submit full size hardware samples as requested by Architect.
1. Items shall remain on file in the Architect's office until all other similar items have been installed in the project. At that time, items on file will become Owner Maintenance Stock.
- D. Informational Submittals:
1. Qualification Data: Submit finish hardware Supplier and Installer qualifications verifying years of experience and hardware manufacturers' certifications; include list of completed projects having similar scope of work identified by name, location, date, reference names and phone numbers.
 - a. Include written proof of certification of all qualified installers and/or hardware installation firms/subcontractors responsible for installation of hardware specified.
 - b. Certifications of installers must be submitted for approval prior to the start of installation.
 2. Templates: Provide necessary templates and/or physical hardware to all trades or factories requiring them so they may cut, reinforce or otherwise prepare their material or product to receive the hardware item. If any manufacturer requires physical hardware, ship to them such hardware via prepaid freight in sufficient time to prevent any delay in the execution of their work.
 3. Keying Schedule: Meet with Architect and Owner to finalize keying requirements and obtain keying instructions in writing. Keying schedule shall be established in compliance with specific requirements determined in consultation with Owner. Furnish a detailed keying system schedule, in Microsoft ExCel format, indicating Owner's approved keying schedule, for Owner review and approval. Include the following:
 - a. Schematic keying diagram
 - b. Index identifying each key set to unique door designations.
 - c. Key codes.

- d. Building numbers.
 - e. Room numbers.
 - c. Bitting list.
4. Wiring Diagrams: After Hardware Schedule has received Architect's approval; submit the following:
- a. Diagrammatic details of electrified door hardware. Include fire alarm and/or access control system interface where applicable. Diagrams shall be complete by opening and shall indicate connections between all components affected. Manufacturers' standard line diagrams are not acceptable. Include the following:
 - 1) System schematic.
 - 2) Point-to-point wiring diagram.
 - 3) Riser diagram.
 - 4) Elevation of each door.
 - b. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
- E. Closeout Submittals:
1. Operations and Maintenance Data: Furnish two copies of the Operation and Maintenance manual. Coordinate delivery with the post-installation job site meeting. The manual shall consist of a hard cover and three-ring binder with the project name on the front. Include the following:
 - a. Maintenance instructions for each item of hardware supplied.
 - b. Copy of the final Door Hardware Schedules for all doors.
 - c. Catalog cuts for all items scheduled.
 - d. Copy of the final Wiring Diagrams.
 - e. Names and phone numbers of the factory representatives for each item supplied.
 - f. Copy of the final Keying Schedule.
 - g. Include any specialized tools needed to maintain the hardware.
 2. Warranty: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Contractor: Assign all finish hardware installation activities to a qualified and experienced hardware Installer; who meets the following criteria:
1. An experienced Installer who has completed finish hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
 2. Factory-certified training in the installation of Locksets, Exit Devices, Door Closers and Power Operators.
 3. At least one certified Installer must be on site during installation for the purpose of guidance and inspection of all hardware installation, to ensure compliance to manufacturers' recommended installation procedures and Arlington County Public Works bid specifications.
 4. Installer shall arrange through Contractor to set up and attend pre-installation conference prior to installing door hardware. This conference shall cover mechanical and electrical hardware components including all locksets, door closers, power operators and exit hardware.
 5. All hardware shall be installed with factory provided fasteners using factory provided installation instructions & templates.
- B. Supplier Qualifications:
1. Recognized architectural finish hardware supplier, with warehousing facilities in Project's

vicinity, who has been furnishing hardware in the Project's vicinity for a period of not less than two years.

- a. Supplier's responsibilities include supplying and installing door hardware. Supplier must employ an Architectural Hardware Consultant who shall be available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware.
 2. Electrified Door Hardware Supplier Qualifications: An experienced finish hardware supplier who has completed projects with electrified door hardware 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, and who is acceptable to manufacturer of primary materials.
 - a. Engineering Responsibility: Prepare data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant and who is experienced in providing consulting services for finish hardware installations that are comparable in material, design, and extent to that indicated for this Project.
1. Electrified Door Hardware Consultant Qualifications: Experienced in providing consulting services for electrified finish hardware installations.
- D. Source Limitations: Obtain each type and variety of finish hardware from a single manufacturer, unless otherwise indicated.
1. Provide electrified finish hardware from same manufacturer as mechanical finish hardware, unless otherwise indicated. Manufacturers that are listed to perform electrical modifications, by a testing and inspecting agency acceptable to authorities having jurisdiction, are acceptable.
- E. Accessibility for Disabled Persons: Special hardware requirements for knurling, slow acting closers or other barrier free opening requirements shall be provided as indicated in the Door Hardware Sets and as required to comply with the U.S. Department of Justice's "ADA Standards for Accessible Design".
- F. Hardware for Fire Doors and Exit Doors: Hardware for fire doors shall conform to NFPA 80; hardware for exit doors shall conform to NFPA 101. Other requirements specified shall also apply. Such hardware shall comply with the applicable UL standards for the intended use specified and be listed in UL BMD, or be labeled and listed by another testing laboratory deemed acceptable by the Owner and Architect.
1. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - a. Test Pressure: After five minutes into the test, neutral pressure level in furnace shall be established at 40" or less above the sill.
- G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- H. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01. In addition to the Contractor's Project Manager and Superintendent, conference participants shall also include Hardware Subcontractor as well as any others requested by the Owner.
1. Coordinate keying with the Arlington County Project Officer, the using agency and

Facilities Management Bureau.

2. Incorporate keying conference decisions into final keying schedule after reviewing finish hardware keying system including, but not limited to, the following:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control cabinet.
- I. Pre-Installation Conference: Conduct conference at Project site. Review methods and procedures related to electrified door hardware including, but not limited to, the following:
 1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
 2. Review sequence of operation for each type of electrified finish hardware.
 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. Review required testing, inspecting, and certifying procedures.
- J. Installation Inspections: Periodic inspections of finish hardware installations will be conducted by the Owner on a continuing on-site basis throughout the time periods of installation.
 1. The Owner will provide feedback information relative to the acceptance or rejection of particular installations to all responsible parties.
- K. Reference Standards: Except as otherwise required by governing authorities or Contract Documents, comply with applicable provisions of Door and Hardware Institute.

1.6 PRODUCT DELIVERY

- A. Deliver finish hardware to the Contractor. Direct factory shipments (drop shipments) to the job site are not acceptable.
 1. Deliver items of hardware at the proper times to the proper locations (shop or project site) in their original individual containers, complete with necessary appurtenances including screws, keys, manufacturers' printed instructions, and where necessary, installation templates for manufacturer's suggested installation. Mark each individual container with the manufacturer's name and catalog number as they appear in the hardware schedule.
- B. Representatives of the Contractor and the Hardware Supplier shall jointly inventory the finish hardware. Replace items damaged in shipment promptly and with proper material without additional cost to the Contractor. Handle all hardware in a manner to eliminate marring, scratching or damage.
- C. Keys and Cores:
 1. Supply construction master keys and cores to Contractor when cylinders are delivered, for use during construction.
 2. Prior to the scheduled completion of the project, manufacturer shall ship all permanent keys and cores, including permanent control keys, directly to the ACPW Maintenance Locksmith Supervisor via Registered Mail, Return Receipt Requested or other pre-approved means. Under no circumstance shall any permanent keys or cores be furnished direct to the Contractor.
 - a. Failure to properly comply with these requirements shall be cause for replacement of cylinders and keys involved at no additional cost to Owner.

1.7 ELECTRICALLY OPERATED HARDWARE

- A. General Requirements: Where "fail safe" electric locking hardware is specified devices shall be connected to building fire and smoke/heat alarm systems. Activation of alarm system shall disengage electric locking mechanism allowing free, unrestricted use of the opening.

1. Coordinate installation of electrically operated hardware to ensure proper size wire is used to power load(s).
 - a. Voltage drop shall not exceed 5% of load's stated voltage.
 - b. Voltage drop shall be calculated by first determining resistance of load ($R=E/I$ voltage divided by AMP draw). Next, determine resistance of wire (per below chart). Divide this number by resistance of load. If result exceeds 5%, wire thickness shall be increased.
 - c. Wire length shall equal distance to load and back to supply (Lock 50 ft. from power supply; wire length = 100 ft.). Two loads powered by one pair of wires draw double current and have half (50%) of resistance.
 - 1) Wire Size Resistance per 1000 feet
 - 2) 12 Gauge 1.6 OHM
 - 3) 14 Gauge 2.5 OHM
 - 4) 16 Gauge 4.1 OHM
 - 5) 18 Gauge 6.4 OHM
 - 6) 20 Gauge 10.1 OHM
 - 7) 22 Gauge 16.0 OHM

1.8 WARRANTIES

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of finish hardware that fails in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and finish hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 2. Warranty Periods:
 - a. Hinges: Life of the Building.
 - b. Manual Closers: Ten years from date of Substantial Completion.
 - c. Continuous Hinges: Ten years from date of Substantial Completion.
 - d. Exit Devices and Locksets:
 - 1) Mechanical: Five years from date of Substantial Completion
 - 2) Electrified: Three years from date of Substantial Completion.
 - e. All other hardware items: Three years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL

- A. Template Hardware: Hardware to be applied to metal or pre-finished doors and frames shall be made to template. Coordinate hardware locations to prevent interference with other hardware items.
- B. Identification: All hardware items shall be clearly and permanently marked by the manufacturer where it will be visible after installation.

2.2 HARDWARE ITEMS

- A. Butt Hinges: Bommer Industries, Inc., Hager Companies or Ives.
 1. Butt hinges shall be Bommer BB5000 Series, Hager BB1279 Series or Ives 5BB1 Series.
 2. Furnish two butt hinges for doors 60-inches or less in height and one additional butt hinge

for each additional 30-inches of height or fraction thereof. Unless otherwise specified, butt hinges for doors through 36-inches wide shall be 4.5 x 4.5; butt hinges for doors over 36-inches wide shall be heavy-weight 5 x 4.5.

3. All butt hinges shall have five knuckles. Furnish non-removable pins (NRP) for all reverse bevel doors receiving keyed locks, rigid outside trim or exit only hardware. Provide butt hinges with holes in the bottom plug to facilitate pin removal.
 4. Butt hinges for labeled doors shall comply with the requirements of NFPA 80.
- B. Continuous Hinges: Bommer Industries, Inc. or Ives.
1. Geared-Type: Full mortise, non-handed, extruded aluminum leaves with interlocking cover and nylon bearings.
- C. Pivots: Architectural Builders Hardware, Ives or Rixson.
1. Where intermediate pivots are specified, spacing shall not exceed 45-inches from centerline of pivot to centerline of pivot.
- D. Cylinders: Schlage Lock Company.
1. Provide scheduled products. The products scheduled shall be used to the exclusion of all others and no other products will be considered to be equal.
 2. Provide cylinders for locksets, deadlocks, exit devices, and all other locking devices indicated in Hardware Sets.
 3. Description:
 - a. Cylinders shall be 6-pin interchangeable core with cores removable by special control key. Confirm core format requirements prior to proceeding with key system development
 - b. Cylinder parts manufactured from brass, bronze, stainless steel, or nickel silver.
 - c. Equip all cylinders with brass color-coded, temporary cores for use during construction and for testing the hardware; plastic cores are prohibited.
 - d. Include all necessary extensions, cams, tail pieces and hardened collars required for a complete installation.
- E. Locks and Latches: Schlage Lock Company.
1. Provide scheduled products. The products scheduled shall be used to the exclusion of all others and no other products will be considered to be equal.
 1. Locks and latches shall be Schlage ND Series with 'Rhodes' trim.
 - a. All internal working parts shall be brass, bronze, steel or stainless steel. For each lock and latchset, provide strike box and square corner ASA strike with curved lips of sufficient length to protect frames; at pairs of doors furnish flat lip strikes.
 - b. Furnish knurling to lever on corridor side of door to all doors leading to hazardous areas (e.g. Mechanical Rooms, Electrical Rooms, Elevator Machine Rooms, etc.).
 2. Furnish keyed devices with cylinder cores keyed to building system.
 3. Electrical Modifications:
 - a. Locks specified to be electrified shall be modified to electrically lock (FS) or electrically unlock (FSE), as indicated, upon receipt of a 24V signal and will remain in this mode until signal is interrupted.
 - b. Locks indicated to have "Request-To-Exit" switches (RX) shall incorporate internal SPDT contacts for remote signaling of operation of the inside lever handle. Switches shall be used in conjunction with the Electronic Security Control System to accommodate "authorized egress".
 - c. Field-connect electrified locks to associated electrified hinges; coordinate electrical connection and installation with Divisions 26 and 28.
- F. Exit Devices and Exit Device Accessories: Von Duprin, Inc.

1. Provide scheduled products. The products scheduled shall be used to the exclusion of all others and no other products will be considered to be equal.
2. Refer to the Hardware Set Schedule for grade and function.
 - a. Where lever handle functions are required on exit devices, they shall match the design and construction of lever handles specified for mortise locks.
 - b. At mortise exit devices, provide strike box and square corner, stainless steel ASA strike with curved lips of sufficient length to protect frames; at pairs of doors furnish flat lip strikes.
3. Exit devices shall be installed with sex nut and shoulder bolt fasteners, devices shall be through bolted on lock and hinge side of doors.
4. Furnish keyed devices with cylinders keyed to building system.
5. Fire Exit Devices: Provide UL-labeled fire-exit hardware at all fire- and smoke-rated openings. Complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire protection, based on testing according to NFPA 252.
6. Electrical Modifications:
 - a. Exit devices specified to be electrified shall be factory modified to electrically lock (FS) or electrically unlock (FSE), as indicated, upon receipt of a 24V signal and will remain in this mode until signal is interrupted.
 - b. Exit devices indicated to have electric latch retraction shall be modified to electrically unlatch (dog down) upon receipt of a 1.0amp, 24V signal and will remain unlatched until signal is interrupted.
 - c. Exit Devices indicated to have "Request-To-Exit" switches (RX) shall incorporate internal SPDT contacts for remote signaling of operation of the push pad. Switches shall be used in conjunction with the Electronic Security Control System to accommodate "authorized egress".
 - d. Field-connect electrified exit devices to associated electrified hinges. Coordinate electrical connection and installation with Divisions 26 and 28.
- G. Automatic Flush Bolts and Coordinators: Ives, Rockwood Manufacturing Company or Triangle Brass Manufacturing Company, Inc.
 1. Coordinators: Provide integral device mounted at head frame, complete with closer brackets as required, for full opening width.
 2. Provide standard strikes with wrought boxes for top bolts.
- H. Surface Closers: Corbin Russwin Architectural Hardware, dormakaba, LCN Closers or Sargent Manufacturing Company.
 1. Surface closers shall be Corbin Russwin DC8000 Series, dormakaba 8900 Series, LCN 4040XP Series or Sargent 281 Series. Closers shall be ISO 9000 certified and stamped with date of manufacturer code.
 2. Closer arms shall be forged and fluid shall accommodate all applicable weather conditions.
 - a. At parallel arm installations, provide manufacturer's heaviest-duty arm assembly.
 3. Where factory sized closers are specified, sizes are to be determined by manufacturer's recommendations for door size, location and applicable handicap requirements.
 - a. Door opening forces shall comply with ADA Standards 309.4 and 404.2.9.
 4. Install surface closers on the least conspicuous side of the door (side opposite public view).
 - a. All closers shall be installed with steel through bolts and non-ferrous back plates. Back plates shall be rectangular in shape and of sufficient size to capture all four bolts in single plate, but not less than 1/2-inch clearance from edge of plate to

- bolt hole. Plate thickness shall not be less than .038" (20-gauge).
- b. Where required to avoid interference with acoustical seals, provide closer mounting brackets for proper frame attachment. Field-paint brackets to match frame finish.
5. Provide surface closers complete with accessory items and attachments, including full metal closer covers, special arms, soffit shoes, and drop plates. Corner bracket installations are not acceptable.
 - a. Closers, covers, brackets and other components shall not extend below bottom of top horizontal rail of door.
- I. Concealed Closers: dormakaba, LCN Closers or Rixson.
1. Overhead concealed closers shall be dormakaba RTS Series or LCN 6030 Series. Closers shall be ISO 9000 certified and stamped with date of manufacturer code.
 2. Concealed closers shall be of heavy-duty cast iron construction. All arms shall be heavy-duty solid forged steel. Concealed closers shall have full rack and pinion, independent closing speed and latch speed regulating valves, and adjustable back check.
 3. Where factory sized concealed closers are specified, sizes are to be determined by manufacturer's recommendations for door size, location and applicable accessibility requirements.
 - a. Door opening forces shall comply with ADA Standards 309.4 and 404.2.9.
 4. Furnish for 180-degree door opening where partition construction will permit.
- J. Overhead Power Operators: ASSA ABLOY Entrances Systems, LCN Closers or Nabco Entrance, Inc.
1. Operators shall be of heavy-duty construction. Sizes are to be determined by manufacturer's recommendations for door size and location.
 - a. Units shall operate as manual door closers unless operator is activated and when power is lost.
 2. Operation: Pressing actuator switch automatically opens door leaf to 90-degrees, operator then manually closes door after variable time delay expires.
 3. Actuators: Provide 4 1/2-inch square wall- and bollard-mounted, and 1 3/4-inch wide jamb-mounted stainless-steel actuator plates as indicated.
 - a. Wireless actuators shall operate at 900MHz, hardwired actuators shall operate on 24V provided by operator.
 - b. Engrave "PUSH TO OPEN" and the Universal Accessibility Symbol on plate; fill with blue enamel paint.
 4. Control Unit:
 - a. Micro-processor controlled.
 - b. Provide adjustable opening speed, adjustable backcheck speed, adjustable closing speed, and adjustable hold-open period.
 - c. Provide built-in 3-position switch for "OFF", "ON" and "HOLD-OPEN" operation and to deactivate actuator switches.
 - d. Provide safety-stop feature: If object or obstruction is encountered during opening and/or closing cycles, door operator stops and slowly returns to closed or open position respectively.
 - e. Provide with safety circuit so that if actuator switch is activated when door is latched or locked, power operator resets without operator and/or door damage.
 5. Accessories: Furnish complete with fastenings, fittings, and other accessories as required for a complete installation.
 6. Manufacturer shall provide detailed wiring diagrams showing point-to-point hook-up of all components affected (e.g. operators, actuators, power, etc.).
 7. Coordinate electrical connection and installation with Divisions 26 and 28.

- K. Architectural Door Trim: Ives, Rockwood Manufacturing Company or Triangle Brass Manufacturing Company, Inc.
1. Protection Plates: Beveled on all sides, fabricated from 0.50-inch thick stainless steel.
 - a. Unless narrow bottom rails dictate a smaller size, armor plates shall be 34-inches high, kick plates shall be 10-inches high, and mop plates shall be 6-inches high.
 - b. Armor plates and kick plates shall be 1 1/2-inches less than the door width on single doors and 1-inch less than the door width on double doors; mop plates shall be 1/2-inch less than the door width on all doors.
 - c. Armor plates on labeled doors shall comply with the requirements of NFPA 80.
 2. Push and Pull Plates:
 - a. Plates shall be beveled on all sides, fabricated from 1/8-inch thick stainless steel.
 - 1) Push plates shall be 6-inches wide and 16-inches high.
 - 2) Pull plates shall be 4-inches wide and 16-inches high.
 - b. Pulls: Provide a minimum 2-1/4-inches clearance. Pulls shall be 10-inches center-to-center, mounted back-to-back with concealed fasteners.
 - 1) Fabricate pulls from 1-inch round solid bar stock.
 3. Push-Pull Bars: Push-pull bars shall be back-to-back mounted. Provide units complete with spacers threaded to accept concealed through bolt attachment including provision for spanner tightening of bolts and assembly. Do not furnish grommets at stile/pull interface.
 4. Fasteners: Furnish all flat goods with Phillips undercut, countersunk screws. Trusshead screws are not acceptable.
- L. Auxiliary Hardware: Ives, Rockwood Manufacturing Company or Triangle Brass Manufacturing Company, Inc.
1. Manual Flush Bolts: Top manual flush bolts shall not exceed 74-inches from floor to centerline.
 2. Provide wall stops equal to Rockwood #403 wherever door strikes wall. Where wall stops are not suitable, furnish floor stops equal to Rockwood #441CU (with removable riser).
 3. Silencers: Furnish rubber silencers equal to Rockwood #608 for hollow metal frames; three per single door and four per pair.
 - a. Silencers are not required at aluminum frames or at doors specified to receive continuous weather-stripping or seals.
- M. Overhead Holders and Stops: Architectural Builders Hardware or Glynn-Johnson.
1. Where wall stops will not work, furnish surface overhead stops equal to Glynn-Johnson #90S.
 2. Holder arms and channels shall be made of extruded bronze or stainless steel.
 3. At wood doors overhead stops shall be installed with sex nut and shoulder bolt fasteners.
- N. Thresholds, Weather-stripping and Seals: National Guard Products, Inc., Pemko Manufacturing Company or Zero International.
1. Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Seals shall be polyurethane, neoprene or silicone, vinyl inserts are not acceptable. Provide noncorrosive fasteners for exterior applications and wet areas.
 2. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated.
 - a. Smoke Seals: At all fire-rated wood doors, all 20-minute rated doors, and any other doors required to be 'smoke resistant', provide the following:
 - 1) Head and Jambs: Smoke seals equal to NGP #5050C.

- 2) Meeting Stile at Pairs: Overlapping astragal seals equal to one NGP #5060C or two NGP #137SA as appropriate for intended hardware operation.
- 3) Refer to the Drawings for locations.
3. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
5. Where required, field-modify thresholds to receive strikes for exit devices and flush bolts.
- O. Magnetic Door Contacts: Interlogix, Schlage Electronics or Securitron Magnalock Corporation.
 1. Unless otherwise indicated, door contacts shall be equal to Interlogix #1076D. Provide built-in, end of line resistors as required by the Electronic Security Control System.
 2. Coordinate electrical connection and installation with Division 28.
- P. Special Tools: Provide any necessary special tools (e.g. spanner and socket wrenches, dogging keys, etc.) required to service and adjust hardware items.

2.3 HARDWARE FINISHES

- A. Base metals: Produce hardware units of basic metal and forming method indicated, using manufacturers standard metal alloy composition, temper and hardness, but in no case of lesser quality than specified or inferred by use of a particular manufacturer's number, style or grade or as established by appropriate referenced specification listed herein.
- B. Finishes: Finishes shall conform to the 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 the standards established by ANSI/BHMA A156.18 or Federal Specifications FF-H-111C as applicable.
 1. All exposed hardware except door closers and hinges shall be satin stainless steel, ANSI/BHMA 630/US32D.
 - a. Factory-finish door closers to match satin stainless steel.
 - b. Butt hinges at exterior doors and doors in wet areas shall be satin stainless steel; butt hinges at all other doors shall be satin chrome plated, ANSI/BHMA 652/US26D.
 - c. Continuous hinges at aluminum storefront doors shall be factory-finished to match storefront, coordinate with Section 08 43 13 "Aluminum-Framed Storefronts" for color.
 - d. Items of hardware not available in stainless steel shall be furnished with a satin chrome plated finish.
 2. Where painting of primed surfaces is required, refer to Division 09 specifications.

2.4 KEYING

- A. General: Key system shall be as directed by the Owner.
 1. Provide the type of system required (e.g. master, grand master, great grand master). Nomenclature and layout shall be consistent with DHI "Keying Systems and Terminology".
 - a. All cylinder cores shall be grand master keyed into the existing Arlington County Public Works' Schlage master key system utilizing the "C" keyway.
 - b. Construction keys and cores shall not be part of, or furnished on the same keyway as, the permanent keying system.
 2. Keying is the responsibility of the Contractor; and shall be performed by the cylinder supplier.
 3. Key System Summary, Cover Sheet, and Letter of Authorization shall accompany Keying Schedule and Purchase Order sent to Factory.

- B. Keys: Provide keys of nickel silver only in the following quantities:
1. Master Keys: Two per set.
 2. Change Keys:
 - a. Locks keyed alike: Two per set.
 - b. Locks keyed different: Two per lock.
 3. Construction Master Keys: Five.
 4. Control keys (for removal of cores): Two permanent and two temporary/construction.
- C. Identification:
1. Permanent keys and all cores shall be marked with applicable blind code for identification. These concealed key control marks or codes shall not include actual key cuts.
 - a. Key and core identification stamping shall be pre-approved by the Owner.
 - b. All key blanks shall be stamped with Owner's exclusive Facility Code and "DO NOT DUPLICATE".
 - c. Failure to properly comply with these requirements shall be cause for replacement of cylinder cores and keys involved at no additional cost to Owner.

2.5 FASTENERS

- A. Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping or sheet metal screws except as specifically indicated.
1. Furnish screws for installation with each hardware item. Provide Phillips flat head or oval head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces of other work, to match the finish of such work as closely as possible, except as otherwise indicated.
 - a. Where wood screws are required, they shall be full thread (to the head) type. Combination wood/machine screws, in lieu of wood screws, are not acceptable.
 2. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard manufactured units of the type specified are available with concealed fasteners.
 3. Furnish fasteners which are compatible with both the unit fastened and the substrate, and which will not cause corrosion or deterioration of hardware, base material reinforcement or fastener. Furnish wall stops with "Toggler" anchors and wood screws. Furnish thresholds and floor stops with lead anchors and 1/4-20 stainless steel machine screws.

PART 3 EXECUTION

3.1 STORAGE AND HANDLING

- A. Representatives of the Contractor and the Hardware Supplier shall jointly inventory the finish hardware. Replace items damaged in shipment promptly and with proper material without additional cost to the Contractor. Handle all hardware in a manner to eliminate marring, scratching or damage.
1. A dry, locked storage space complete with adequate shelving shall be set aside for the purpose of unpacking, sorting out, checking and storage. Control the handling and installation of hardware items, whether immediately replaceable or not, so completion of the work will not be delayed by losses before or after installation.
 2. Tag each item or package separately, with identification related to the final approved hardware schedule, and include basic installation instructions in the package. Furnish hardware items of proper design for use on doors and frames of thickness, profile, swing, security and similar requirements indicated as necessary for proper installation and function.

3.2 COORDINATION

- A. Coordinate Finish Hardware Schedule submission and hardware ordering to insure delivery of all items as directed by the Contractor.
 - 1. Prior to ordering any hardware, examine the shop drawings and details of doors and frames and other substrate suppliers to determine that the proper type and size pieces of hardware are being furnished. No extra for material or labor will be allowed for any corrections that should have been eliminated by proper prior coordination.
- B. Templates: Distribute finish hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing finish hardware to comply with indicated requirements.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified finish hardware with connections to power supplies, fire alarm system and detection devices, and access control system.
- D. Concrete, reinforcement, and formwork requirements are specified in Division 03.

3.3 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 INSTALLATION

- A. Install each hardware item in accordance with final approved Hardware Schedule and manufacturer's instructions.
 - 1. Set hardware level, plumb and true to line and location.
 - 2. Adjust and reinforce attachment substrate as required for proper installation and operation of hardware.
 - 3. Drill and countersink units which are not factory-prepared for anchorage fasteners; space fasteners and anchors uniformly, in accordance with industry standards.
- B. Hardware Mounting Heights:
 - 1. Provide heights as indicated on Drawings, except as otherwise required for compliance with governing regulations.
 - 2. Where heights are not indicated, comply with mounting requirements of DHI "Recommended Locations for Builder's Hardware" on custom steel doors and frames.
- C. Fire Doors and Exit Doors: Hardware for labeled fire doors shall be installed in accordance with the requirements of NFPA 80. Hardware for listed exit doors shall be installed in accordance with the requirements of NFPA 101.
 - 1. Where panic exit devices are required on fire rated doors, (with supplementary marking on door U.L. label indicating "Fire Door to be Equipped with Fire Exit Hardware") provide U.L. label on exit device indicating "Fire Exit Hardware."
- D. Hinges: Install steel doors and wood doors to comply with reference standards, as specified in door sections.
 - 1. Where shimming is required to comply with tolerances, provide metal shims only.
- E. Electrified Hardware:

1. Pre-wire and make field connections between all electrically operated and monitored hardware items including, but not limited to, locks, exit devices, power transfers and magnetic door contacts.
 2. All wiring must be 18 gauge or thicker.
- F. Closers:
1. Do not install parallel arm closers until after weather-stripping or seals have been installed on head frame (where weather-stripping or seals are scheduled).
 2. Do not cut weather-stripping or seals for attachment of closer brackets or shoes.
 3. Adjust closers to control door swing and to provide positive latching of doors.
 - a. Adjust closers not to exceed following manual opening forces:
 - 1) Exterior doors: As required to close and latch each leaf.
 - 2) Interior doors (non-fire-rated): Maximum 5-pound opening force.
 - 3) Fire-rated doors: As required to close and latch each leaf.
 - b. After air-handling system has been balanced, make final adjustment of all closers.
- G. Door Stops: Install stops for maximum degree of door opening swing allowed by conditions of installation.
1. Locate floor stops so as not to create a tripping hazard.
 2. Locate wall stops centered on spindle of lever handles.
- H. Weather-stripping and Seals:
1. Install continuous around door heads and jambs, and meeting stiles of pairs of doors.
 2. Install bottom weather-stripping and automatic door bottoms for full width of door.
 3. Do not cut weather-stripping or seals for attachment of closer brackets or shoes.
 4. Align rain drips with the bottom edge of the door frame rabbet.
 5. Set all rain drips and exterior thresholds in full bed of mastic sealant and attach with stainless steel fasteners.
- I. Cylinder Cores:
1. When notified by the Owner, remove construction cores.
 2. After removal, verify that all locking components (e.g. collars, tailpieces, etc.) are still intact.
 3. It is the Contractor's responsibility to return the construction cores and keys to the manufacturer. Construction cores and keys remain the property of the Cylinder Manufacturer.
 4. The Owner will install permanent cores.
- J. Key Control System: Assist the Owner with the integration of new keys into their existing key control system, as determined by final keying schedule:
1. Contractor shall sort, label and tag all keys, set up keying index, and review with the Arlington County Project Officer.
- K. Coordination with Adjacent Finishes:
1. If cutting and fitting are required to install hardware onto or into surfaces that are later painted or finished in another way, install each item completely and then remove and store in secure place during finish application.
 2. After completion of finishes, reinstall each item.
 3. Do not install surface mounted items until finishes are complete on substrate.

3.5 ADJUST AND CLEAN

- A. General: To insure proper operation and function of every unit, adjust and check each operating item of hardware and each door. Lubricate moving parts with type lubrication recommended by the manufacturer (graphite-type if no other recommended). Replace unit that

cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain finish hardware and finish hardware finishes. Verify that the Owner has been supplied with manufacturers' installation and maintenance manuals, product data, and any special adjusting tools normally supplied by the manufacturer.
- B. Continuity Testing: Inspect all connections between electrically operated and monitored hardware items including, but not limited to, electrified locks and exit devices, power transfers and power supplies. Upon completion of inspection, furnish the Architect with itemized report indicating any problems found and steps taken to repair anomalies.
- C. Final Adjustment: Wherever hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and perform a final check and adjustment of all hardware items in such space or area. Clean and re-lubricate as necessary to restore proper function and finish of hardware and doors.
 1. Prior to acceptance of any electrical hardware system, an operational test shall be performed to determine if devices are functioning as intended by the specifications. Wiring shall be tested for correct voltage, current-carrying capacity, and proper grounding. Stray voltages in lock wiring shall be eliminated to prevent locking devices from releasing in critical situations.
 2. Factory representatives shall inspect all exit devices and door closers prior to final acceptance to ensure proper installation and adjustment. A written report shall be filed with the Architect and Owner after inspection.
- D. Final Inspection and Acceptance: Prior to completion of Project, the Owner will perform a comprehensive punch-out inspection of all hardware installations and provide appropriate feedback/notification to all responsible parties.
 1. All inspections conducted by the Owner shall be in accordance with all manufacturer's recommended procedures and specifications.
 2. The contractor is obligated to provide remedial repair and correction in a timely manner, not to exceed two calendar weeks or ten working days.
 3. In lieu of timely correction, the Owner reserves the right to employ certified representatives to correct all deficiencies not properly addressed or executed by the contractor in the time frame outlined. Payment to correct these deficiencies shall be back charged to the contractor.

3.6 HARDWARE SET SCHEDULE

1. See Drawings.

END OF SECTION

SECTION 08 80 00 - GLAZING**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Glass.
- B. Glazing compounds and accessories.

1.2 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- B. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2015).
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- D. ASTM C1036 - Standard Specification for Flat Glass 2016.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- G. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2010.
- H. GANA (GM) - GANA Glazing Manual 2008.
- I. GANA (SM) - GANA Sealant Manual 2008.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit two samples 12 by 12 inch in size of glass units.
- E. Certificates: Certify that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.

1.5 MOCK-UP

- A. Locate within framing set in masonry mockup.

1.6 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

1.7 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

- B. Sealed Insulating Glass Units: Provide a ten (10) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- C. Laminated Glass: Provide a five (5) year warranty to include coverage for delamination, including replacement of failed units.

PART 2 PRODUCTS

2.1 INSULATING GLASS UNITS

2.2 EXTERIOR GLAZING ASSEMBLIES

- A. Performance Criteria: Select type and thickness of glass to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass calculated in accordance with IBC 2012 - International Building Code.

- 1. Glass thicknesses listed are minimum.

2.3 GLASS MATERIALS

- A. Glass Manufacturers:

- 1. Cardinal Glass Industries: www.cardinalcorp.com.
- 2. Guardian Industries Corp: www.sunguardglass.com.
- 3. AGC Flat Glass North America: www.afgglass.com.
- 4. Pilkington North America Inc: www.pilkington.com/na.
- 5. PPG Industries, Inc: www.ppgideascales.com.

- B. Float Glass: Provide float glass based glazing unless noted otherwise.

- 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
- 2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and Kind FT.
- 3. Tinted Types: ASTM C1036, Class 2 - Tinted, color and performance characteristics as indicated.
- 4. Thicknesses: As indicated; for exterior glazing comply with requirements indicated for wind load design regardless of thickness indicated.

- C. Clear Float Glass : Clear, annealed.

- 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
- 2. 6 mm minimum thick.

- D. Safety Glass : Clear; fully tempered with horizontal tempering.

- 1. Comply with 16 CFR 1201 test requirements for Category II.
- 2. 6 mm minimum thick.
- 3. Provide this type of glazing in the locations indicated on the drawings.

2.4 SEALED INSULATING GLASS UNITS

- A. Manufacturers: Any of the glass manufacturers with fabrication capabilities or fabricator in good standing with glass manufacturer including, but not limited to, one of the following:

- 1. JE Berhowitz, L.P.
- 2. Oldcastle Glass.
- 3. TGI, Inc.
- 4. Viracon, Apogee Enterprises, Inc: www.viracon.com.

- B. Sealed Insulating Glass Units: Types as indicated.

- 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
- 2. Edge Seal: Glass to elastomer with supplementary silicone sealant.
- 3. Purge interpane space with dry hermetic air.

- C. Insulated Glass Units: Double pane with glass to elastomer edge seal.
 - 1. Durability: Certified by an independent testing agency to comply with ASTM E 2190.
 - 2. Purge interpane space with dry hermetic air.
 - 3. Total unit thickness of 1 inch .
 - 4. Basis-of-Design - Clear Insulating Units: Guardian SuperNeutral 54 or equal or better product of other named manufacturers.
 - a. Overall Unit Thickness and Thickness of Each Lite: 25 and 6.0 mm.
 - b. Interspace Content: Air.
 - c. Outdoor Lite: Class 1 (clear) float glass; Kind FT (fully tempered).
 - d. Indoor Lite: Class 1 (clear) float glass; Kind FT (fully tempered).
 - e. Low-E Coating: Second or third surface.
 - f. Visible Light Transmittance: 54 percent minimum.
 - g. Winter Nighttime U-Factor: 0.28 or better.
 - h. Summer Daytime U-Factor: 0.27 or better.
 - i. Solar Heat Gain Coefficient: 0.28 maximum.
 - j. Outdoor Visible Reflectance: 13 percent maximum.
- D. Sealing System: Dual seal, with primary and secondary sealants as follows:
 - 1. Primary seal shall be extruded polyisobutylene continuously bonded to glass surfaces and desiccant filled metal spacer, including corners.
 - 2. Minimum width of primary seal shall be 0.125 inch (3.2 mm). Secondary seal shall be General Electric IGS 3723 or Dow Corning 982.
 - 3. Secondary seal shall completely cover spacer with no gaps or voids, and shall be continuously bonded to both plates of glass.
 - 4. Where insulating glass is supported by structural silicone, secondary seal shall be designed to transfer specified pressures from outdoor glass to indoor glass.
- E. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
 - 1. Spacer Material: Stainless steel or thermally jacketed stainless steel.
 - 2. Desiccant: Molecular sieve or silica gel, or blend of both.
 - 3. Corner Construction: Manufacturer's standard corner construction.

2.5 GLAZING COMPOUNDS

- A. Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.
- B. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.6 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option
 - I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option
 - I. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with

or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products as follows:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
1. Type 1, for glazing applications in which tape acts as the primary sealant.
 2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- E. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option I; black color.
- F. Glazing Clips: Manufacturer's standard type.
- 2.7 Panel Thickness: As necessary to have flush face appearance to aluminum framing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealants in accordance with ASTM C1193 and GANA Sealant Manual.
- E. Install sealants in accordance with manufacturer's instructions.

3.3 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)

- A. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.4 INSTALLATION - EXTERIOR DRY METHOD (TAPE AND GASKET SPLINE GLAZING)

- A. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- D. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.

E. Trim protruding tape edge.

3.5 INSTALLATION - INTERIOR DRY METHOD (TAPE AND TAPE)

- A. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- D. Place glazing tape on free perimeter of glazing in same manner described above.
- E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- F. Knife trim protruding tape.

3.6 FIELD QUALITY CONTROL

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

3.7 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

3.8 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

END OF SECTION

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SECTION 08 83 00 - MIRRORS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Glass mirrors.

1.2 REFERENCE STANDARDS

- A. ASTM C1036 - Standard Specification for Flat Glass 2016.
- B. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.
- C. GANA (GM) - GANA Glazing Manual 2008.
- D. GANA (SM) - GANA Sealant Manual 2008.
- E. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors) 2011.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. VOC Submittal: Provide product data for field-applied mastics indicating VOC content in g/L; comply with limits of Section 01 61 16.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and GANA (SM) for glazing installation methods.
- B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with recommendations of GANA (TIPS).

1.5 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

- B. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (mirror select); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
 - 1. Thickness: 1/4 inch.
 - 2. Size: As noted on drawings.

2.2 ACCESSORIES

- A. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- B. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
 - 1. Product produced specifically for setting mirrors.
 - 2. Product certified by mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors are installed.
 - 3. Sealants applied within the building waterproofing envelope: Comply with low-emitting requirements.
 - 4. Manufacturers:
 - a. Gunther Mirror Mastics.
 - b. Palmer Products Corporation.
 - c. Bohle.
- C. Top and Bottom Trim: Aluminum extrusions with a return deep enough to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
 - 1. Bottom Trim: L-bars formed with back leg not less than 7/8 inch (9.5 and 22 mm) in height, and a thickness of not less than 0.05 inch (1.3 mm).
 - a. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 01 60 00 "Product Requirements."
 - b. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:
 - 1) Laurence, C. R. Co., Inc.; CRL Standard "J" Bar.
 - 2) Product in first subparagraph below is 0.05 inch (1.3 mm) thick.
 - 3) Sommer & Maca Industries, Inc.; Heavy Gauge Aluminum Shallow Nose "L" Moulding Lower Bar.
 - 4) Stylmark; L-Molding Lower Bar.
 - 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.062 inch (1.57 mm).
 - a. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 01 60 00 "Product Requirements."
 - b. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include:
 - 1) Laurence, C. R. Co., Inc.; CRL Deep "J" Channel.
 - 2) Product in first subparagraph below is 0.062 inch (1.57 mm) thick.
 - 3) Sommer & Maca Industries, Inc.; Heavy Gauge Aluminum Deep Nose "J" Moulding Lower Bar.
 - 4) Stylmark; J-Molding Upper Bar.
- D. Finish: Clear bright anodized.

- E. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

2.3 FABRICATION

- A. Mirror Sizes: To suit Project conditions, cut mirrors to final sizes and shapes.
- B. Cutouts: Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
- C. Mirror Edge Treatment: Flat polished edge.
 - 1. Seal edges of mirrors after edge treatment to prevent chemical or atmospheric penetration of glass coating.
- D. Film-Backed Safety Mirrors:
 - 1. Apply film backing with pressure-sensitive adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.
 - 2. Use adhesives and film backing compatible with mirror backing paint as certified by mirror manufacturer.
 - 3. Provide film backing on all glass mirrors.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.

3.2 INSTALLATION

- A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Do not permit edges of mirrors to be exposed to standing water.
- E. Wall-Mounted Mirrors:
 - 1. Install mirrors with mastic and mirror channels.
 - 2. Install mirror hardware that are fabricated in single lengths to fit and cover top and bottom edges of mirrors.
 - 3. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - c. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch between back of mirrors and mounting surface.

3.3 CLEANING

- A. Remove labels after work is complete.
- B. Clean mirrors and adjacent surfaces.

3.4 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION

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SECTION 08 91 00 - LOUVERS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Louvers, frames, and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 90 05 - Joint Sealers.

1.3 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2015.
- C. AMCA 511 - Certified Ratings Program for Air Control Devices 2010.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.
- D. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior and interior surfaces.
- E. Test Reports: Independent agency reports showing compliance with specified performance criteria.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
 - 1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Airolite Company, LLC: www.airolite.com.
- B. All-Lite Architectural Products: www.alllite.com.
- C. Construction Specialties, Inc; RS-7315 (basis-of-design): www.c-sgroup.com.
- D. Greenheck Fan Corporation: www.greenheck.com.

E. Industrial Louvers, Inc: www.industriallouvers.com.

F. Ruskin Company: Model EME720.

2.2 LOUVERS

A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.

1. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
2. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
3. Screens: Provide bird screens.

B. Deep Storm Resistant Fixed Horizontal Louver:

1. Material: Heads, sills, jambs and mullions to be one-piece structural aluminum members with integral caulking slot and retaining beads.
2. Design: Architectural line drainable sightproof storm resistant fixed-blade; designed to collect and drain water to exterior at sill by means of multiple gutters in blades and channels in jambs and mullions.
3. Louvers to be supplied with 4 inches high by full depth sill flashings formed from minimum 0.050 inch thick aluminum; sill flashings to have welded side panels.
4. Frame: 7 inches deep, channel profile; corner joints mitered and welded.
5. AMCA Performance: (48 inches wide by 48 inches high test unit)
 - a. Free Area: Minimum 8.0 sq. ft.
 - b. Intake pressure drop at 900 fpm free area velocity: Minimum 0.32 in. H2O.
 - c. Exhaust pressure drop at 900 fpm free area velocity: Minimum 0.44 in. H2O.
6. Wind Driven Rain Performance:
 - a. The louver test based on a 1.00m by 1.00m core area; unit tested at a rainfall rate of 3.0 inches per hour and with a wind directed to the face of the louver at a velocity 29.1-mph.
 - b. The test data to show the water penetration effectiveness rating at each corresponding ventilation rate.

2.3 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Polyvinylidene Fluoride Coating: Minimum 70 percent Kynar 500/Hylar 500 resin, three coat finish, complying with AAMA 2605.

1. Color: Custom, to match approved sample.

2.4 ACCESSORIES

A. Blank-Off Panels: Same material as louver, painted black on exterior side.

1. Provide where indicated and where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
2. Uninsulated Panels: Provide at unconditioned spaces; minimum 0.050 inch thick aluminum sheet.
3. Insulated Panels: Provide at conditioned spaces or where indicated.
 - a. 1 inch thick and faced on both sides with minimum 0.032 inch thick aluminum sheet.
 - b. Fabricated with an expanded polystyrene (EPS) core.
 - c. Panel perimeter frame to be 0.050 inch thick-formed aluminum channels; panel frame mitered at the corners.

4. Finish: Same quality as louvers.
- B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.
 1. Bird screens to be minimum 5/8 inch mesh, 0.050 inch thick expanded and flattened aluminum bird screen secured within minimum 0.055 inch thick extruded aluminum frames; frames to have mitered corners and corner locks.
- C. Glazing Adapter: Provide where louvers are glazed into storefront or curtainwall frames; minimum 0.090 inch thick extruded aluminum.
- D. Fasteners and Anchors: Stainless steel.
- E. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
- F. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.
- G. Sealant: ES-1 or ES-4 type, as specified in Section 07 90 05.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.

3.2 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louver frames in openings with concealed fasteners.
- E. Install perimeter sealant and backing rod in accordance with Section 07 90 05.

3.3 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

END OF SECTION

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SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Shaft wall system.
- C. Fire rated area separation walls.
- D. Acoustic insulation.
- E. Gypsum sheathing.
- F. Gypsum wallboard.
- G. Glass mat faced gypsum board.
- H. Moisture and mold resistant wallboard.
- I. Impact-resistant gypsum board.
- J. Joint treatment and accessories.

1.2 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- C. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- D. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base 2019.
- E. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing 2018.
- F. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- G. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels 2019.
- H. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2016.
- I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- J. ASTM E413 - Classification for Rating Sound Insulation 2016.
- K. GA-216 - Application and Finishing of Gypsum Panel Products 2016.
- L. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association 2016.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.
- D. Submit drawings indicating proposed location of control joints for Architect's review; locations to be approved by Architect and may be adjusted for aesthetic reasons.

1.4 QUALITY ASSURANCE

- A. Maintain one copy of all installation standards at project site.
- B. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.
 - 1. Maintain one copy of standards at project site.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire Rated Assemblies: Provide completed assemblies identical to those tested in assembly indicated.

2.2 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. CertainTeed Corporation: www.certainteed.com.
 - 2. Continental Building Products: www.continental-bp.com.
 - 3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 - 4. Lafarge North America: www.lafarge.com.
 - 5. National Gypsum Company: www.nationalgypsum.com.
 - 6. USG Corporation: www.usg.com.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Regular Type:
 - a. Application: Use for vertical surfaces, unless otherwise indicated.
 - b. Edges: Tapered.
 - c. Recycled Content: Provide regular type gypsum panel products with minimum 80 percent recycled content, including recycled content face paper; provide Type X with minimum 10 percent recycled content.
 - 2. Fire Resistant Type: Complying with Type X requirements; UL or WH rated.
 - a. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X.
 - b. Edges: Tapered.
 - 3. Ceiling Board: Special sag-resistant type.
 - a. Application: Ceilings, except areas with showers or otherwise indicated.
 - b. Thickness: 1/2 inch.
 - c. Edges: Tapered.
- C. Impact Resistant Wallboard:
 - 1. Application: Shaft-wall assemblies and where Drawings indicate impact- or abuse-resistant gypsum wallboard.
 - 2. Surface Abrasion: 2, minimum, when tested in accordance with ASTM C1629/C1629M.

3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 5. Hard Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 7. Type: Fire resistance rated Type X, UL or WH listed.
 8. Thickness: 5/8 inch.
 9. Edges: Tapered.
 10. Products:
 - a. Continental Building Products; Protecta HIR 300 Type X with Mold Defense.
 - b. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant.
 - c. National Gypsum Company; Gold Bond HI-Impact XP Gypsum Board.
 - d. National Gypsum Company; Gold Bond eXP Interior Extreme IR Gypsum Panel.
- D. Moisture and Mold Resistant Wallboard: Wallboard installed at building perimeter, and any wallboard furred to concrete or masonry construction.
1. Characteristics:
 - a. ASTM C 1396 (Section 5) regular type except where Type X fire-resistant type is indicated or required by to meet UL assembly types.
 - b. Edges: Tapered.
 - c. Resists the growth of mold when tested, as manufactured, according to ASTM D 3273.
 2. Available Products:
 - a. SHEETROCK® Brand Mold Tough® Gypsum Panels by USG.
 - b. Gold Bond® BRAND XP® Wallboard by National Gypsum.
 - c. Mold Defense Products by LaFarge.

2.3 FIBERGLASS REINFORCED BOARD MATERIALS

- A. Glass Mat Gypsum Board: Gypsum panels with moisture-resistant core and coated inorganic fiberglass mat back surface designed to resist growth of mold and mildew, per ASTM D 3273.
1. Glass Mat Board: Comply with performance requirements of ASTM C 1396/C 1396M for water-resistant gypsum backing board and ASTM C 1177/C 1177M for sheathing; tapered long edges.
 2. Application: High-humidity or wet locations; walls or ceilings; high-humidity or wet locations include kitchen areas and adjacent service areas, areas with showers, janitor basins, gang toilets, mechanical penthouses and mechanical spaces with steam, hot water or condensation generating equipment.
 - a. Available Products:
 - 1) DensArmor Plus Interior Guard by G-P Gypsum.
 - 2) EXP Extreme by National Gypsum.
 3. Application: Sheathing.
 - a. Basis-of-Design: Dens-Glass Gold Exterior Guard by G-P Gypsum; Type X.
 - b. Other Available Products: CertainTeed GlasRoc Brand Sheathing; Type X, e2xp Extended Exposure Sheathing by National Gypsum Company.
 4. Application: Shaftwall.
 - a. Basis-of-Design: Dens-Glass Ultra Shaft Guard by G-P Gypsum.

- b. Contractor Option: The contractor may provide the following instead of Basis-of-Design Product.
 - 1) Fire-Shield Shaftliner XP panels by National Gypsum.
 - 2) Sheetrock Brand Gypsum Liner Panels Mold Tough by USG.
- 5. Application: Exterior soffits.
 - a. Available Products:
 - 1) Dens-Glass Gold Exterior Guard by G-P Gypsum.
 - 2) CertainTeed GlasRoc Brand Sheathing.
 - b. Core: 5/8 inch, Type X.
 - c. Finish: G-P Setting Compound followed by G-P Finish Coat.
- B. Sheathing Joint and Penetration Treatment:
 - 1. Silicone Emulsion Sealant: ASTM C 834, compatible with sheathing tape and sheathing, recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

2.4 ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced.
- B. Thickness as scheduled by partition schedule by dimension or STC assembly.
- C. Acoustic Insulation: $\{rs\#1\}$; preformed glass fiber, friction fit type, unfaced. Thickness: inch.
- D. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
 - 1. Comply with low-emitting requirements specified in Section 01 81 13.
- E. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
 - 2. Available products include the following:
 - a. Grabber Construction Products: No-Coat Prefinished Corners.
 - b. US Gypsum Company; Beadex Paper-Faced Metal Drywall Bead and Trim.
- F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Joint Tape: Paper for interior applications; 10-by-10 glass mesh for exterior locations and glass mat gypsum wallboard; 2 inch wide.
 - 2. Ready-mixed vinyl-based joint compound.
- G. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
- H. Screws: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.
- I. Adhesives Applied within the Building Waterproofing Envelope: Comply with low-emitting requirements.
- J. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.

3. Finish:
 - a. Corrosion-resistant primer compatible with joint compound and finish materials specified.
 - b. Silicone polyester enamel finish coat; custom color to be selected.
4. Reveals, Trims and Molding: As indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.2 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 1. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.4 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
 1. Cut boards at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
 - a. Install boards with a 3/8-inch setback where non-load-bearing construction abuts structural elements.
 - b. Install boards with a 1/4-inch setback where they abut masonry or similar materials that might retain moisture, to prevent wicking.
 2. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.
 3. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.

4. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.
 5. Screw-attach boards at perimeter and within field of board to each steel stud; space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
 6. Seal sheathing joints according to sheathing manufacturer's written recommendations.
 - a. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed sealant in entire face of tape.
 - b. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered.
 - c. Seal other penetrations and openings.
- F. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.
 3. Apply glass-fiber tape to glass mat faced gypsum board joints, and apply and trowel silicone emulsion sealant to embed sealant in entire face of tape.
 4. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered.
 5. Seal other penetrations and openings.
 6. Prepare for specified finish according to manufacturer's instructions.
- G. Glass Mat Faced Gypsum Board: Install in strict accordance with manufacturer's instructions.
- H. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.
- I. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.
- ### 3.5 INSTALLATION OF TRIM AND ACCESSORIES
- A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 2. At exterior soffits, not more than 30 feet apart in both directions.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- ### 3.6 JOINT TREATMENT
- A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 2. Level 5: Walls and ceilings to receive Decorative Semi-Rigid Wall Covering, semi-gloss or gloss paint finish and other areas specifically indicated.
 3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 4. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
 5. Level 0: Temporary partitions.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
1. Feather coats of joint compound so that camber is maximum 1/32 inch.

- D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.7 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

1.2 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members 2012.
- B. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
- G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2020.
- H. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate prefabricated work, component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
 - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- C. Product Data: Provide data describing head to structure connectors showing compliance with requirements, head to structure connectors showing compliance with requirements, head to structure connectors showing compliance with requirements, head to structure connectors showing compliance with requirements, and head to structure connectors showing compliance with requirements.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.4 PROJECT CONDITIONS

- A. Coordinate the placement of components to be installed within stud framing system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
 - 1. Clarkwestern Dietrich Building Systems LLC: www.clarkdeitrich.com.
 - 2. Dietrich Metal Framing: www.dietrichindustries.com.
 - 3. Marino: www.marinoware.com.
- B. Slip-Type Head Joints:
 - 1. Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
 - 2. Superior Metal Trim; Superior Flex Track System (SFT).
 - 3. Dietrich Metal Framing; Fast Top Clip.
- C. Firestop Tracks:
 - 1. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
 - 2. Metal-Lite, Inc.; The System.
 - 3. Clark Western; Brady's Sliptrack within UL assembly.
 - 4. Dietrich Metal Framing; SLP-TRK within UL assembly.
- D. Metal Back-up Plates:
 - 1. Metal Lite, Inc., Anaheim, CA.
- E. Grid Suspension System for Gypsum Board Ceilings and Bulkheads:
 - 1. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - 2. Chicago Metallic Corporation; Drywall Furring System.
 - 3. USG Corporation; Drywall Suspension System.

2.2 FRAMING MATERIALS

- A. Recycled Content: Provide steel with at least 25 percent post-consumer recycled content.
- B. Regional Materials: Provide at least 25 percent of steel manufactured and containing recycled raw materials recovered within 100 mile radius of Project Site.
- C. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Studs: C shaped with flat or formed webs with knurled faces.
 - a. Typical: Minimum 0.0283 inch, 22 gage (27 mil) except when reference standard states a more stringent requirement.
 - b. At door and glazed opening jambs, and framing supporting ceramic tile: Minimum 0.0312 inch, 20 gage (30 mil) except when reference standard states a more stringent requirement.
 - c. Note: The Architect will accept "Effective Thickness" listed UltraSTEEL Framing, with independent test data.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C shaped.
 - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
- D. Loadbearing Studs: As specified in Section 05 40 00.
- E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- F. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.

1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
 2. Material: ASTM A653/A653M steel sheet, SS Grade 50, with G60/Z180 hot dipped galvanized coating.
 3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
 4. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.
- G. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.
- H. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.
- I. Fasteners: ASTM C1002 self-piercing tapping screws.
- J. Sheet Metal Backing: 0.036 inch thick, galvanized.
- K. Anchorage Devices: Power actuated.
- L. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: [] inch ([] mm).
- M. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board. Provide [] manufactured by [] .
1. Comply with low-emitting requirements specified in Section 01 81 13.
- N. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic.
- 2.3 FABRICATION
- A. Fabricate assemblies of framed sections to sizes and profiles required.
 - B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.1 INSTALLATION OF STUD FRAMING

- A. Comply with requirements of ASTM C754.
- B. Extend partition framing to structure where indicated and to ceiling in other locations.
- C. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- D. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- E. Align and secure top and bottom runners at 24 inches on center.
- F. Place one bead of acoustic sealant between runners and substrate , studs and adjacent construction.
- G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- H. Install studs vertically at spacing indicated on drawings.
- I. Align stud web openings horizontally.
- J. Secure studs to tracks using crimping method. Do not weld.

- K. Stud splicing is not permissible.
- L. Fabricate corners using a minimum of three studs.
- M. Double stud at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- N. Coordinate erection of studs with requirements of door frames; install supports and attachments.
- O. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- P. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.
- Q. Provide metal backup plates as required to accommodate the wall hung casework, millwork, railings or other items mounted to metal stud and wallboard walls and partitions; provide plates up to 8 feet in length as one-piece units.

3.2 CEILING AND SOFFIT FRAMING

- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.
- H. Laterally brace suspension system.
- I. Contractor Option - Grid Suspension System for Gypsum Board Ceilings and Bulkheads: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

3.3 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 30 00 - TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Tile for shower receptors.
- D. Cementitious backer board as tile substrate.
- E. Coated glass mat backer board as tile substrate.
- F. Stone thresholds.
- G. Trims.
- H. Waterproofing and crack isolation membrane.

1.2 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium) 2019.
- B. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium). 2017.
 - 1. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2017.
 - 2. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 2017.
 - 3. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement 1999 (Reaffirmed 2016).
 - 4. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive 2009 (Revised).
 - 5. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).
 - 6. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy 1999 (Reaffirmed 2010).
 - 7. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout 1999 (Reaffirmed 2010).
 - 8. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2010).
 - 9. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 2017.
 - 10. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium). 2017.
 - 11. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).

12. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2016).
 13. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar 2012 (Revised).
 14. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation 2010 (Reaffirmed 2016).
 15. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units 1999 (Reaffirmed 2016).
 16. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium). 2017.
 17. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2019.
 18. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products 2018.
- C. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2019.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

1.4 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.

1.5 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.7 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

1.8 EXTRA MATERIALS

- A. Extra Tile: 2 percent of each size, color, and surface finish combination, but not less than one box of each type.
- B. Turn over any cut tile exceeding 50 percent of a full tile, as extra materials.

PART 2 PRODUCTS

2.1 TILE

- A. Porcelain Tile: ANSI A137.1, standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Edges: Cushioned.
 - 3. Surface Finish: Unglazed.
 - 4. Color(s): To be selected by Architect from manufacturer's standard range.
 - 5. Trim Units: Matching cove base and cove shapes in sizes coordinated with field tile.

2.2 TRIM AND ACCESSORIES

- A. Ceramic Trim: Matching cove base and cove ceramic shapes in sizes coordinated with field tile where indicated on the drawings.
 - 1. Applications:
 - a. Open Edges: Bullnose.
 - b. Inside Corners: Jointed.
 - c. Floor to Wall Joints: Cove base.
 - 2. Manufacturers: Same as for tile.
- B. Thresholds: Marble, gray, honed finish; 5 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.
 - 1. Applications:
 - a. At doorways where tile terminates, unless indicated otherwise.
 - b. At open edge of shower stalls using ceramic mosaic tile as basin.

2.3 SETTING MATERIALS

- A. Latex-Portland Cement Mortar Bond Coat - Thin Set and Medium Bed: ANSI A118.4.
 - 1. Products:
 - a. ARDEX Engineered Cements: www.ardexamericas.com
 - b. Custom Building Products: www.custombuildingproducts.com.
 - c. Bonsal American, Inc: www.sakrete.com.
 - d. Bostik Inc: www.bostik-us.com.
 - e. MAPEI Corporation.
 - f. TEC Specialty Products, Inc.
 - 2. Medium Bed Locations: Where required to produce slope; product that is approved by manufacturer for application thickness of 5/8 inch (16 mm).

2.4 GROUTS

- A. Manufacturers:
 - 1. ARDEX Engineered Cements: www.ardexamericas.com.
 - 2. Bonsal American, Inc: www.sakrete.com
 - 3. Bostik Inc: www.bostik-us.com/#sle.
 - 4. Custom Building Products: www.custombuildingproducts.com/#sle.
 - 5. LATICRETE International, Inc: www.laticrete.com/#sle.
 - 6. TEC, an H.B. Fuller Construction Products Brand: www.tecspecialty.com/#sle.
 - 7. Custom Building Products: www.custombuildingproducts.com.
 - 8. MAPEI Corporation.
- B. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.

1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
3. Colors: As selected by Architect from manufacturer's full line.

2.5 ACCESSORY MATERIALS

- A. Waterproofing and Crack Isolation Membrane: Fluid-applied acrylic-based membrane with reinforcing mesh, complying with ANSI A118.10.
 1. Basis-of-Design: Mapei Corporation; Mapelastic HPG with Fiberglass Mesh.
 2. Equivalent product of listed setting and grouting material manufacturers.
 3. Location: All tile floors; full coverage.
- B. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
 1. Product: Durock Brand Cement Board manufactured by United States Gypsum Company.
 - a. Contractor Option: PermaBase Brand Cement Board, by National Gypsum Company.
 2. Location: Wet walls and high-humidity areas (not required at corridor locations).
- C. Tile Backer Panel:
 1. Mold-resistance: Passes ASTM D 3273.
 2. Compliance with Standards: Meets ASTM C 1278 and meets or exceeds the physical requirements of ASTM C 630 and ASTM c 1178.
 3. Use: Approved by manufacturer for use as tile backer panel.
 4. No paper face.
 5. Basis-of-Design: Fiberock Brand Aqua-Tough Interior Panel manufactured by United States Gypsum Company.
 6. Contractor Option: DensShield Tile Backer manufactured by Georgia-Pacific or e2xp Tile Baker, by National Gypsum Company.
 7. Location: Walls not requiring cementitious backer board as specified.
- D. Metal Edge Strips:
 1. Use metal trims at all tile edges.
 2. At Shower Entries:
 - a. Description: two-part splashguard profile with a 3/4" (19 mm) wide anodized aluminum support section and PVC insert that together form the visible surface between the tiled floors and walls.
 - b. Splashguard Insert:
 - 1) Collapsible Straight Lip
 - c. Basis-of-Design: Schluter SHOWERPROFILE-WS.
 3. At wall tile edging and outside corners:
 - a. Description: Profile with a 1/8" (3.5 mm) reveal for outside corners of tiled walls, and 135 Degree integrated trapezoid-perforated anchoring leg.
 - b. Corners:
 - 1) Provide with matching outside corners
 - c. Material and Finish:
 - 1) E - Stainless Steel Type 304 = V2A
 - d. Basis-of-Design: Schluter FINEC.
 4. Open Edge of Tile with Adjacent Finish of Similar Height:

- a. General: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications, stainless steel; ASTM A 666, 300 Series exposed-edge material.
 - b. Basis-of-Design: 1.1 Schluter-SCHIENE Edge-protecting Profile; stainless steel.
5. Open Edge of Tile with Adjacent Finish of Different Height:
- a. General: ADA-compliant profile, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications, stainless steel; ASTM A 666, 300 Series exposed-edge material.
 - b. Basis-of-Design:
 - 1) 1.2 Schluter-RENO-U Reducer Profile, where tile surface is higher than adjacent finish; stainless steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install cementitious backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of dry-set mortar to a feather edge.

3.3 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.

- F. Install thresholds where indicated.
 - G. Sound tile after setting. Replace hollow sounding units.
 - H. Keep control and expansion joints free of mortar, grout, and adhesive.
 - I. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
 - J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
 - K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
 - L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
 - M. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.
- 3.4 INSTALLATION - FLOORS - THIN-SET AND MEDIUM BED METHODS
- A. Provide specified waterproofing and crack isolation membrane for all tile floor areas; install in accordance with TCA Method F122, with latex-portland cement grout.
- 3.5 INSTALLATION - FLOORS - MORTAR BED METHODS
- A. Mortar Bed Thickness: 5/8 inch, unless otherwise indicated.
- 3.6 INSTALLATION - SHOWERS AND BATHTUB WALLS
- A. At tiled shower receptors install in accordance with The Tile Council of North America Handbook Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls. Latex-Portland cement mortar bond coat with latex-Portland cement grout. Waterproof membrane turned up walls a minimum of 6 inches above finished floor.
- 3.7 INSTALLATION - WALL TILE
- A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.
 - B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.
 - C. Shower Walls:
 - 1. Over interior concrete and masonry install in accordance with TCA Handbook Method W211, bonded mortar bed with latex-Portland cement bond coat; with latex-Portland cement grout.
 - 2. Include waterproofing membrane over mortar bed of W211.
- 3.8 CLEANING
- A. Clean tile and grout surfaces.
- 3.9 PROTECTION
- A. Do not permit traffic over finished floor surface for 4 days after installation.
 - B. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
 - C. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION

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SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Acoustical units.

1.2 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2017.
- B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2019.
- C. UL (FRD) - Fire Resistance Directory Current Edition.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items; show the following:
 - 1. Ceiling suspension system members.
 - 2. Method of attaching suspension system hangers to building structure.
 - 3. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
 - 4. Minimum Drawing Scale: 1/8 inch = 1 ft.
- C. Product Data: Provide data on suspension system components.
- D. Samples: Submit two full size samples illustrating material and finish of acoustical units.

1.4 QUALITY ASSURANCE

- A. Fire-Resistive Assemblies: Complete assembly listed and classified by UL (FRD) for the fire resistance indicated.

1.5 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.6 PROJECT CONDITIONS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Install acoustical units after interior wet work is dry.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size units equal to 12 cases.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

A. Manufacturers:

1. Armstrong World Industries, Inc: www.armstrong.com. - Basis-of-Design.
2. CertainTeed Corporation: www.certainteed.com.
3. USG: www.usg.com.

B. General:

1. Recycled Content: Provide acoustical ceiling panels with minimum 50 percent recycled content; provide steel with minimum 25 percent post-consumer recycled content.
2. Acoustical ceiling panels: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 or GREENGUARD Gold certification.

C. Acoustical Units - General: ASTM E1264, Class A.

1. Units for Installation in Fire-Rated Suspension System: Listed and classified for the fire-resistive assembly as part of suspension system.

2.2 SUSPENSION SYSTEM(S)

A. Manufacturers:

1. Armstrong World Industries, Inc: www.armstrong.com.
2. CertainTeed Corporation: www.certainteed.com.
3. Chicago Metallic Corporation: www.chicagometallic.com.
4. USG: www.usg.com.

B. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

C. ExposedSteel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.

1. Profile: Tee; 15/16 inch wide dimensional tee system.
2. Construction: Double web.
3. Finish: White painted.
4. Basis-of-Design Product: see finish schedule

2.3 EXTRUDED PERIMETER TRIM

A. Manufacturers:

1. Armstrong World Industries, Inc; Product Axiom: www.armstrong.com.
2. Chicago Metallic Corporation; Product Infinity: www.chicagometallic.com.
3. USG; Product Compasso: www.usg.com.
4. CertainTeed Ceilings, Cloud Perimeter Trim

B. Location:

1. Edge trim system for transitions between drywall and suspended ceilings.
2. Boundry trim system for isolated hung areas of suspended ceilings.

C. Components:

1. Extruded aluminum alloy 6063 trim channel.
2. Attachment to grid system is provided by tee-bar connection clips which lock into bosses on the trim channel and are screw-attached to the web of the intersecting suspension system members.
3. Sections of trim are joined together using the splice plate.

2.4 ACCESSORIES

- #### A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

- B. Perimeter Moldings: Same material and finish as grid.
 - 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C 636, ASTM E 580, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Install in bed of acoustical sealant.
 - 2. Use longest practical lengths.
 - 3. Overlap and rivet corners.
- K. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.

3.2 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units with pattern parallel to longest room axis.
- D. Fit border trim neatly against abutting surfaces.
- E. Install units after above-ceiling work is complete.
- F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- G. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.

- H. Where round obstructions occur, provide preformed closures to match perimeter molding.
- I. Install hold-down clips on panels within 20 ft of an exterior door.

3.3 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 65 00 - RESILIENT FLOORING**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

1.2 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
- B. ASTM F1861 - Standard Specification for Resilient Wall Base 2016.
- C. ASTM F2195 - Standard Specification for Linoleum Floor Tile 2018.
- D. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2019.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
- E. Certification: Submit written certification by manufacturer declaring products do not contain asbestos.
- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.5 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS**2.1 GENERAL**

- A. Resilient flooring: Comply with California Department of Public Health (CDPH) Standard Method v1.1- 2010 or Resilient Floor Covering Institute' s (RFCI) FloorScore Certification.

2.2 SOLID VINYL FLOOR PLANK

- A. Manufacturer: Subject to compliance with requirements, provide Shaw Contract.
- B. Tile Standard: ASTM F 1700.
 - a. Class: Class III printed film vinyl plank.
 - b. Type: B, embossed surface with wear layer.
- C. Overall Thickness: 0.127 inch.
- D. Sizes: 6 by 48 inches.
- E. Colors and Patterns: Wood pattern as listed in Finish Material Schedule

2.3 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 - A. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or ASTM E 648.
 - B. Height: 4 inch.
 - C. Thickness: 0.125 inch thick.
 - D. Finish: Satin.
 - E. Length: Roll.
 - F. Color: see the finish schedule
 - G. Manufacturers:
 - a. Johnsonite, a Tarkett Company: www.johnsonite.com.

2.4 ACCESSORIES

- A. Subfloor Filler: Latex-modified portland cement based or blended hydraulic cement based formulation; type recommended by adhesive material manufacturer.
- B. Moldings, Transition and Edge Strips: Metal.
- C. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive resilient flooring.
- C. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- D. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

- E. Verify that concrete sub-floor surfaces are ready for resilient flooring installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
 - A. Moisture emission rate: Not greater than 3 lb per 1000 sq ft per 24 hours when tested using calcium chloride moisture test kit for 72 hours.
 - B. Alkalinity: pH range of 5-9.
- F. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is cured.
- C. Clean substrate.
- D. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's instructions.
- C. Adhesive-Applied Installation:
 - A. Spread only enough adhesive to permit installation of materials before initial set.
 - B. Fit joints and butt seams tightly.
 - C. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- G. Set flooring in place, press with heavy roller to attain full adhesion.

3.4 TILE FLOORING

- A. Comply with manufacturer's written instructions for installing each type of floor planks.
- B. Lay out floor planks 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. Discard broken, cracked, chipped, or deformed tiles

Lay tiles square with room axis and with grain direction in ashlar pattern or as shown on Finish Plans.

- C. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical pipes and door frames. Extend floor tiles to center of door openings.
- D. 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.

- E. Adhere vinyl plank and vinyl composition floor tiles to flooring 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.

3.5 RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.6 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.
- C. Apply sealer in two coats as instructed by flooring manufacturer.

3.7 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.
- B. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
- C. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION

SECTION 09 68 13 - TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.2 REFERENCE STANDARDS

- A. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2011.
- B. CRI 104 - Standard for Installation of Commercial Textile Floorcovering Materials; Carpet and Rug Institute; 2002.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate layout of joints.
- C. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Submit two, 12 inch long samples of edge strip.
- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed, with a minimum of 1 full box of each type, color, and pattern.

1.4 INSTALLER QUALIFICATIONS

- A. Company specializing in performing Work of this Section with minimum five years experience.
- B. Installers trained, accepted and certified by the carpet manufacturer, or FCIB, IFCI or CRI certified carpet installers.

1.5 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General:
 - 1. Carpet: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 or Carpet and Rug Institute's (CRI) Green Label Plus (GLP).
 - 2. Recycled Content: Provide carpet with recycled content.

2.2 ACCESSORIES

- A. Sub-Floor Filler: Cementitious type; type recommended by flooring material manufacturer.
- B. Edge Strips: Rubber, color as selected by Architect.
- C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- B. Vacuum clean substrate.

3.3 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Install carpet tile in accordance with manufacturer's instructions and CRI 104.
- D. Blend carpet from different cartons to ensure minimal variation in color match.
- E. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- F. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- G. Locate change of color or pattern between rooms under door centerline.
- H. Fully adhere carpet tile to substrate.
- I. Trim carpet tile neatly at walls and around interruptions.
- J. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Galvanized metal.
 - 5. Wood.
 - 6. Gypsum board.
 - 7. Wood fiber acoustical panels.
 - 8. Cotton or canvas insulation coverings.
 - 9. Exposed PVC piping.
- B. Project includes painted murals or graphics within event spaces; following application of specified interior paint system, apply graphics with specified top coat and the use of precision cut masking films manufactured especially for paint masking - similar to court graphics.

1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.

1.3 DEFINITIONS

- A. Gloss Ranges:
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 - 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 - 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 REFERENCE STANDARDS

- A. ASTM D 3359 - Standard Test Methods for Measuring Adhesion by Tape.
- B. SSPC (PM1) - Good Painting Practice: SSPC Painting Manual, Vol. 1; Society for Protective Coatings.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for each type of product submitted.
- C. Samples for Initial Selection: Submit each type of topcoat product indicated.
- D. Samples for Verification: Submit each type of paint system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, minimum 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.

4. Label each Sample for location and application area.
 - E. Product List: Submit each product indicated, include the following:
 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - F. Maintenance Materials: Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 1. Quantity: Furnish an additional 5 percent, but not less than 2 gal. of each material and color applied.
- 1.6 QUALITY ASSURANCE
- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- 1.7 MOCK-UP
- A. Benchmark Samples (Mock-ups): Provide benchmark finish sample (all coats) for each coating type and substrate.
 1. Architect will select several rooms or surfaces to represent surfaces and conditions, for application of each paint system type and substrate; colors will be provided for Benchmark Samples.
 - a. Wall Surfaces: Complete minimum 100 square feet.
 - b. Small Areas and Items: Apply systems to items designated by the Architect.
 2. Complete Benchmark Samples per the requirements of this Section.
 - a. Provide required sheen, color and texture for each surface.
 - b. Architect-accepted Benchmark Samples to establish level of quality for remainder of Work.
 3. Architect to provide final color approvals from Benchmark Samples and intermediate coat wall colors; refer to subsection 3.3 of this Section.
 4. Benchmark samples to be prepared by individuals performing the remaining Work for this Project.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
 - B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
 - C. 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 and a maximum 90 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.
- 1.9 FIELD CONDITIONS
- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
 - B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Benjamin Moore & Co.
- B. Behr Process Corporation.
- C. PPG Paints.
- D. Sherwin-Williams Company.
- E. McCormick Paints.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors:
 - 1. As selected by Architect from manufacturer's full range.
 - 2. Different colors may be used in the same room.
 - 3. Colors of frames may be different than doors.
 - 4. Colors for ceilings and trim may be different from walls, and walls may be more than one color or striped.
 - 5. Dark tints may be used on metal frames that may require more coats than that indicated on paint schedule for proper coverage; apply as many coats as necessary for complete hide.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. Use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
 - C. Seal surfaces that might cause bleed through or staining of topcoat.
 - D. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
 - E. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
 - F. Insulated Coverings to be Painted: Remove dirt, grease, and oil from canvas and cotton.
 - G. 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.
 - H. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - I. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
 - J. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 - K. Passivated Galvanized Steel: Clean with a water-based industrial strength cleaner, and/or "Brush Blast" in accordance with SSPC-SP7. After the surface has been prepared, apply recommended primer to a small area. Allow primer to cure for 7 days, and test adhesion using the "cross-hatch adhesion tape test" method in accordance with ASTM D 3359. If the adhesion of the primer is positive, proceed with a recommended coating system for galvanized metal.
 - L. 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.
 - M. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.
 - N. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- ### 3.3 COLOR COORDINATION
- A. Tint intermediate coats for wall surfaces to match color sample selections.

- B. Architect will visit the Project within 7 days after notification, to review primed walls for final color coordination.
- C. Allow 3 week days in schedule for Architect to change final wall colors between intermediate coat and remaining coat(s).
- D. Allow time to order final paint colors; do not order final paint colors until obtaining final color approvals.

3.4 APPLICATION

- A. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - 2. Wall Surfaces: Receive final color approvals following Architect's review of Intermediate Coats, before proceeding.
 - 3. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - 4. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 5. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- B. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - a. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 - 3. 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.
 - 4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 5. Finish doors on tops, bottoms, and side edges the same as faces.
- C. Block Fillers:
 - 1. Apply two coats of block filler to concrete masonry block at a rate to ensure complete coverage with pores filled.
 - 2. Perform a squeegee operation on second coat to fill all crevices and produce a smooth surface; do not remove filler material from surface with the squeegee operation.

- D. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
1. Wall Surfaces: Tint Prime Coat a lighter shade to facilitate identification; tint Prime Coat to match color of finish coat, but provide sufficient difference in shade to distinguish Prime Coat from Intermediate Coat used for final color selections.
 2. Other Surfaces: 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.
- E. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- F. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- G. 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.
- H. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
 - d. Exposed wiremold and conduit in all finished spaces to match color of wall.
- I. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Acoustical wall panels.
 - c. Metal toilet enclosures.

- d. Metal lockers.
 - e. Elevator entrance doors and frames.
 - f. Elevator equipment.
 - g. Finished mechanical and electrical equipment.
 - h. Light fixtures.
2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas.
 - c. Ceiling plenums.
 - d. Utility tunnels.
 - e. Pipe spaces.
 - f. Duct shafts.
 - g. Elevator shafts.
 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
 6. Items indicated to receive other finishes.
 7. Items indicated to remain unfinished.
 8. Floors, unless specifically so indicated.
 9. Ceramic and other tiles.
 10. Acoustical materials, unless specifically so indicated.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINT SCHEDULE

- A. Concrete and Masonry Other Than Concrete Masonry Units:
 1. Semi-Gloss Sheen:

- a. Benjamin Moore & Co.:
 - 1) Primer (Unpainted Surfaces): Ultra Spec Masonry Int/Ext Acrylic Sealer (608).
 - 2) First and Second Coats: Ultra Spec 500 Waterborne Zero VOC Semi-Gloss N539.
 - b. Behr Process Corporation:
 - 1) Primer: Premium Plus Interior All-In-One Primer & Sealer, 75
 - 2) First and Second Coats: Behr Pro i300 Interior Semi-Gloss Paint, 370
 - c. PPG Paints:
 - 1) Primer (Unpainted Surfaces): Speedhide Zero Int. Latex Quick Drying Primer/Sealer, 6-4900XI.
 - 2) First and Second Coats: Speedhide Zero Interior Flat Latex, 6-4510XI.
 - d. Sherwin-Williams Company:
 - 1) Primer (Unpainted Surfaces): Loxon Concrete and Masonry Primer LX02 Series.
 - 2) First and Second Coats: ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2650 Series.
 - e. McCormick Paints:
 - 1) Primer (Unpainted Surfaces): Acrylok Interior/Exterior 100% Acrylic Masonry Primer 06451.
 - 2) First and Second Coats: McCormick Total Advantage Zero VOC Professional Coating Semi-Gloss 10 Series .
- B. Concrete Masonry Units:
- 1. Semi-Gloss Sheen:
 - a. Benjamin Moore & Co.:
 - 1) Block Filler (Unpainted Surfaces): Ultra Spec Hi-Build Masonry Block Filler (571).
 - 2) First and Second Coats: Ultra Spec 500 Waterborne Interior Semi-Gloss N539.
 - b. Behr Process Corporation:
 - 1) Block Filler (Unfinished Surfaces): Behr Pro Block Filler Primer, 50
 - 2) First and Second Coats: Behr Pro i300 Interior Semi-Gloss Paint, 370
 - c. PPG Architectural Coatings; Glidden Professional:
 - 1) Block Filler (Unpainted Surfaces): Concrete Coatings Interior/Exterior Block Filler 3010.
 - 2) First and Second Coats: Ultra-Hide No VOC Semi-Gloss Paint 1415.
 - d. PPG Architectural Coatings; PPG Paints:
 - 1) Block Filler (Unpainted Surfaces): Speedhide Latex Block Filler 6-15XI.
 - 2) First and Second Coats: Speedhide Zero Interior Semi-Gloss Latex Enamel, 6-4510XI Series.
 - e. Sherwin-Williams Company:
 - 1) Block Filler (Unpainted Surfaces): PrepRite Latex Block Filler B25W25.
 - 2) First and Second Coats: ProMar 200 Zero VOC Interior Latex S/G, B31-2650 Series.
 - f. McCormick Paints:

- 1) Block Filler (Unpainted Surfaces): McCormick Interior/Exterior Latex Block Filler 01015.
 - 2) First and Second Coats: McCormick Total Advantage Zero VOC Professional Coating Semi-Gloss 10 Series.
- C. Gypsum Board:
1. Flat Sheen: Ceilings.
 - a. Benjamin Moore & Co.:
 - 1) Primer (Unpainted Surfaces): Ultra Spec 500 Waterborne Zero VOC Primer Sealer N534.
 - 2) First and Second Coats: Ultra Spec 500 Waterborne Zero VOC Flat N536.
 - b. Behr Process Corporation:
 - 1) Primer (Unpainted Surfaces) Interior Drywall Primer & Sealer, 73
 - 2) First and Second Coats: Behr Pro i300 Interior Flat Paint, 310
 - c. PPG Paints:
 - 1) Primer (Unpainted Surfaces): Speedhide Zero Int. Latex Quick Drying Primer/Sealer, 6-4900XI.
 - 2) First and Second Coats: Speedhide Zero Interior Flat Latex 1, 6-4110XISeries.
 - d. Sherwin-Williams Company:
 - 1) Primer (Unpainted Surfaces): ProMar 200 Zero VOC Interior Latex Primer, B28W2600.
 - 2) First and Second Coats: ProMar 200 Zero VOC Interior Latex Flat, B30-2650 Series.
 - e. McCormick Paints:
 - 1) Primer (Unpainted Surfaces): McCormick 1st Step Interior Vinyl Primer Sealer 06431.
 - 2) First and Second Coats: McCormick Total Advantage Zero VOC Professional Coating Flat 08 Series.
 2. Low-Luster, Satin or Eggshell Sheen:
 - a. Benjamin Moore & Co.:
 - 1) Primer (Unfinished Surfaces): Ultra Spec 500 Waterborne Interior Primer Sealer N534.
 - 2) First and Second Coats: Ultra Spec 500 Waterborne Zero VOC Eggshell Enamel N538.
 - b. Behr Process Corporation:
 - 1) Primer (Unpainted Surfaces) Interior Drywall Primer & Sealer, 73
 - 2) First and Second Coats: Behr Pro i300 Interior Eggshell Paint, 330
 - c. PPG Paints:
 - 1) Primer (Unfinished Surfaces): Speedhide Zero Latex Quick Drying Primer/Sealer, 6-4900XI.
 - 2) First and Second Coats: Speedhide Zero Interior Eggshell Latex 6-4310XI Series.
 - d. Sherwin-Williams Company:
 - 1) Primer (Unfinished Surfaces): ProMar 200 Zero VOC Interior Latex Primer, B28W2600.

- 2) First and Second Coats: ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-2650 Series.
- e. McCormick Paints:
 - 1) Primer (Unpainted Surfaces): McCormick 1st Step Interior Vinyl Primer Sealer 06431.
 - 2) First and Second Coats: McCormick Total Advantage Zero VOC Professional Coating Eggshell 09 Series.
- D. Woodwork and Hardboard - Painted:
 - 1. Semi-Gloss Sheen:
 - a. Benjamin Moore & Co.:
 - 1) Undercoat (Unfinished Surfaces): Fresh Start 100% Acrylic Superior Primer 023.
 - 2) First and Second Coats: Ultra Spec 500 Waterborne Interior Zero VOC Semi-Gloss 539.
 - b. Behr Process Corporation:
 - 1) Primer (Unpainted Surfaces) Interior All-In-One Primer & Sealer, 75
 - 2) First and Second Coats: Behr Pro i300 Interior Semi-Gloss Paint, 370
 - c. PPG Architectural Coatings; PPG Paints:
 - 1) Undercoat (Unfinished Surfaces): 17-921 Seal Grip Interior/Exterior Acrylic Universal Primer
 - 2) First and Second Coats: Speedhide Zero Interior Semi-Gloss Latex Enamel, 6-4510XI Series.
 - d. Sherwin-Williams Company:
 - 1) Undercoat (Unfinished Surfaces): Multi-Purpose Waterbased Acrylic-Alkyd Primer B79-450.
 - 2) First and Second Coats: ProMar 200 Zero VOC Interior Latex S/G, B31-2600 Series; or Pro Industrial Acrylic Coating S/G B66-650 (Doors & Frames).
 - e. McCormick Paints:
 - 1) Undercoat (Unpainted Surfaces): McCormick 1st Step Interior Latex Enamel Undercoater and Primer Sealer 06441.
 - 2) First and Second Coats: McCormick Total Advantage Zero VOC Professional Coating Semi-Gloss 10 Series.
 - E. Mechanical and Electrical Items: Use 3-coat system best suited to substrate, satin finish. Use heat resistant materials where required.
 - F. Ferrous Metal:
 - 1. Semi-Gloss Sheen:
 - a. Benjamin Moore & Co.:
 - 1) Primer (Unfinished Surfaces): Ultra Spec HP Acrylic Metal Primer HP04.
 - 2) First and Second Coats: Ultra Spec 500 Waterborne Interior Semi-Gloss 539.
 - b. Behr Process Corporation:
 - 1) Primer (Unfinished Surfaces): Premium Plus Multi-Surface Primer, 436
 - 2) First and Second Coats: Behr Pro i300 Interior Semi-Gloss Paint, 370
 - c. PPG Paints:
 - 1) Primer (Unfinished Surfaces): Pitt Tech Plus 4020 PF

- 2) First and Second Coats: Speedhide Zero Interior Semi-Gloss Latex Enamel, 6-4510XI Series.
 - d. Sherwin-Williams Company:
 - 1) Primer (Unfinished Surfaces): Pro-Cryl Universal Primer, B66-1310 Series.
 - 2) First and Second Coats: ProMar 200 Latex Gloss, B11-2200 Series; or Pro Industrial Acrylic Coating S/G, B66-650 (Doors & Frames).
 - e. McCormick Paints:
 - 1) Primer (Unfinished Surfaces): Corotech Acrylic Metal Primer V110.
 - 2) First and Second Coats: McCormick Interlok Interior/Exterior Acrylic Semi-Gloss Urethane DTM 45 Series or comparable product.
- G. Zinc-Coated (Galvanized) Metal:
- 1. Semi-Gloss Sheen:
 - a. Benjamin Moore & Co.:
 - 1) Primer (Unfinished Surfaces): Ultra Spec HP Acrylic Metal Primer HP04.
 - 2) First and Second Coats: Ultra Spec 500 Waterborne Interior Semi-Gloss 539.
 - b. Behr Process Corporation:
 - 1) Primer (Unfinished Surfaces): Premium Plus Multi-Surface Primer, 436
 - 2) First and Second Coats: Behr Pro i300 Interior Semi-Gloss Paint, 370
 - c. PPG Paints:
 - 1) Primer (Unfinished Surfaces): Pitt Tech Plus 4020PF
 - 2) First and Second Coats: Speedhide Zero Interior Semi-Gloss Latex Enamel, 6-4510XI Series.
 - d. Sherwin-Williams Company:
 - 1) Primer (Unfinished Surfaces): ProCryl Universal Primer, B66-1310 Series.
 - 2) First and Second Coats: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series.
 - e. McCormick Paints:
 - 1) Primer (Unfinished Surfaces): McCormick Underlok Interior/Exterior Acrylic Latex Multi Purpose Primer 06452.
 - 2) First and Second Coats: McCormick Interlok Interior/Exterior Acrylic Semi-Gloss Urethane DTM 45 Series or comparable product.
 - H. Overhead Exposed Construction (Deck, Joists, Steel): One coat flat dry fallout coating system to cover formulated for compatibility with all substrates by any paint manufacturer specified in this Section. Use 100 percent acrylic, flash-rust-resistance dryfall.
 - 1. Benjamin Moore & Co.: Benjamin Moore Latex Dry Fall- Flat (395).
 - 2. Behr: Behr Pro Dryfall Paint Flat, 890
 - 3. PPG Paints: Speedhide Super Tech WB Interior 100% Acrylic Dry-Fog Latex 6-724XI, 6-725XI.
 - 4. Sherwin-Williams Company: Pro Industrial Waterborne Acrylic Dryfall Flat, B42W00181.
 - 5. McCormick Paints: Interior Waterborne Acrylic Dry Fall.
 - I. Cotton or Canvas Insulation-Covering Substrates, Including Pipe and Duct Coverings:
 - 1. Benjamin Moore & Co.:
 - a. Primer: Ultra Spec 500 Interior Zero VOC Latex Primer N534.

- b. First and Second Coats: Ultra Spec 500 Interior Zero VOC Latex Eggshell, N538.
 - 2. Behr Process Corporation:
 - a. Primer: Kilz 2 Interior/Exterior Water-Base Primer, 2000
 - b. First and Second Coats: Behr Pro i300 Interior Eggshell Paint, 330
 - 3. PPG Paints:
 - a. Primer: Speedhide Zero Int. Latex Quick Drying Primer/Sealer, 6-4900XI.
 - b. First and Second Coats: Speedhide Zero Interior Eggshell Latex Enamel, 6-4310XI Series.
 - 4. Sherwin-Williams Company:
 - a. Primer: Multi-Purpose Latex Primer B51-450
 - b. First and Second Coats: ProMar 200 Zero VOC Latex Eg-Shel, B202600 Series.
 - 5. McCormick Paints:
 - a. Top Coat: McCormick Total Advantage Zero VOC Professional Coating Eggshell 09 Series.
- J. Exposed PVC Piping:
- 1. Benjamin Moore & Co.:
 - a. Bond Coat: STIX Waterborne Bonding Primer SXA-110; Insl-X.
 - b. First and Second Coats: Ultra Spec 500 Interior Zero VOC Latex Eggshell, 538.
 - 2. Behr Process Corporation:
 - a. Primer: Kilz Adhesion Interior/Exterior Water-Base Bonding Primer, 2111
 - b. First and Second Coats: Behr Pro i300 Interior Eggshell Paint, 330
 - 3. PPG Paints:
 - a. Bond Coat: SEAL GRIP 17-921 Interior/Exterior 100% Acrylic Universal Primer/Sealer.
 - b. First and Second Coats: Speedhide Zero Interior Eggshell Latex Enamel, 6-4310XI Series.
 - 4. Sherwin-Williams Company:
 - a. Bond Coat: Zero VOC Multi Purpose Primer B 51-450 Series.
 - b. First and Second Coats: ProMar 200 Zero VOC Latex Eg-Shel, B202600 Series.
 - 5. McCormick Paints:
 - a. Prime Coat: McCormick Underlok Interior/Exterior Acrylic Latex Multi Purpose Primer 06452.
 - b. Top Coat: McCormick Total Advantage Zero VOC Professional Coating Eggshell 09 Series.

END OF SECTION

SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - 1. Interior Substrates:
 - a. Concrete masonry units (CMU).
 - b. Gypsum board.
 - 2. Exterior Substrates:
 - a. Exposed concrete designated for painted finish.
 - b. Concrete masonry units (CMU).
 - c. Exposed steel canopy structure and other rooftop structures.
 - d. Exposed angle lintels and hung plates.
 - 3. All substrates listed in the schedule at the end of this Section may not be required for this project.

1.2 DEFINITIONS

- A. Gloss Ranges:
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 - 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 - 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product indicated.
- C. Samples for Initial Selection: For each type of finish-coat product indicated.
- D. Samples for Verification: For each type of coating system and in each color and gloss of finish coat indicated.
 - 1. Submit Samples on rigid backing, minimum 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- E. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - a. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.5 MOCK-UP

- A. Benchmark Samples (Mock-ups): Provide benchmark finish sample (all coats) for each coating type and substrate.
 - 1. Architect will select several rooms or surfaces to represent surfaces and conditions, for application of each paint system type and substrate; colors will be provided for Benchmark Samples.
 - a. Wall Surfaces: Complete minimum 100 square feet.
 - b. Small Areas and Items: Apply systems to items designated by the Architect.
 - 2. Complete Benchmark Samples per the requirements of this Section.
 - a. Provide required sheen, color and texture for each surface.
 - b. Architect-accepted Benchmark Samples to establish level of quality for remainder of Work.
 - 3. Architect to provide final color approvals from Benchmark Samples and intermediate coat wall colors; refer to subsection 3.3 of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Benjamin Moore & Co.
- B. Tnemec Company, Inc.
- C. International Paint LLC.
- D. PPG Paints.
- E. Sherwin-Williams Company.

2.2 HIGH-PERFORMANCE COATINGS, 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.
 - 2. Provide products of same manufacturer for each coat in a coating system.
- B. Colors: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Masonry (CMU): 12 percent.
 - b. Gypsum Board: 12 percent.
 - c. Concrete: 12 percent.
 - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 4. Coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
- D. CMU Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust and loose mill scale.
 - 1. Clean using methods recommended in writing by coating manufacturer.
 - 2. Blast clean according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3.3 COLOR COORDINATION

- A. Tint intermediate coats for wall surfaces to match color sample selections.
- B. Architect will visit the Project within 7 days after notification, to review primed walls for final color coordination.
- C. Allow 3 week days in schedule for Architect to change final wall colors between intermediate coat and remaining coat(s).
- D. Allow time to order final paint colors; do not order final paint colors until obtaining final color approvals.

3.4 APPLICATION

- A. Apply in accordance with manufacturer's instructions.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Wall Surfaces: Receive final color approvals following Architect's review of Intermediate Coats, before proceeding.
 3. Omit primer over metal surfaces that have been shop primed and touchup painted.
 4. If undercoats or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 5. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Apply high-performance coatings according to manufacturer's written instructions.
1. Use applicators and techniques suited for coating and substrate indicated.
 2. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - a. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 3. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 4. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- D. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- E. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
1. Wall Surfaces: Tint Prime Coat a lighter shade to facilitate identification; tint Prime Coat to match color of finish coat, but provide sufficient difference in shade to distinguish Prime Coat from Intermediate Coat used for final color selections.
 2. Other Surfaces: 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.
- F. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

- G. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- H. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.
- I. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

3.5 CLEANING

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Pigmented Polyurethane over Epoxy System (Gloss):

a. Benjamin Moore & Company:

- 1) Prime Coat: Corotech Polyamide Epoxy V400.
- 2) Intermediate Coat: Corotech Polyamide Epoxy V400.
- 3) Topcoat - Gloss: Corotech Aliphatic Acrylic Urethane Coating Gloss V500.

b. International Paint LLC:

- 1) Prime Coat: Devran 203.
- 2) Intermediate Coat: Devran 203.
- 3) Topcoat - Gloss: Devthane 379 Series.

c. PPG Paints:

- 1) Prime Coat: Amerlock 2 VOC Epoxy Coating.
- 2) Intermediate Coat: Amerlock 2 VOC Epoxy Coating.
- 3) Topcoat - Gloss: Amershield VOC Acrylic Polyurethane

d. Sherwin-Williams Company:

- 1) Prime Coat: S-W Pro Industrial Waterbased Catalyzed Epoxy Finish, B73-300 Series. B73-300
- 2) Intermediate Coat: S-W Pro Industrial Waterbased Catalyzed Epoxy Finish, B73- 300 Series.
- 3) Topcoat - Gloss: S-W Acrolon Waterbased Acrolon 100 WB Urethane.

e. Themec Company, Inc.:

- 1) Prime Coat: Series 27 W.B. Typoxy.
- 2) Intermediate Coat: Series 27 W.B. Typoxy.
- 3) Topcoat - Semi-Gloss: Series 1081 Endura-Shield.
- 4) Topcoat - Gloss: Series 1080 Endura-Shield.

B. CMU Substrates:

1. Pigmented Polyurethane over High-Build Epoxy System - Gloss:
 - a. Benjamin Moore & Company:
 - 1) Block Filler: Corotech Epoxy Block Filler V163.
 - 2) Intermediate Coat: Corotech Polyamide Epoxy V400.
 - 3) Topcoat: Corotech Aliphatic Acrylic Urethane Coating Gloss V500.
 - b. International Paint LLC:
 - 1) Prime Coat: Tru-Glaze-WB 4015.
 - 2) Intermediate Coat: Bar-Rust 231 Series.
 - 3) Topcoat - Gloss: Devthane 379 Series.
 - c. PPG Paints:
 - 1) Prime Coat: Amercoat 68HS VOC Zinc Rich Epoxy Primer.
 - 2) Intermediate Coat: Amerlock 2 VOC Epoxy Coating.
 - 3) Topcoat: Amershield VOC Acrylic Polyurethane.
 - d. Sherwin-Williams Company:
 - 1) Prime Coat: Epoxy, S-W Cement Plex 875 Acrylic Block Filler.
 - 2) Intermediate Coat: S-W Pro Industrial Waterbased Catalyzed Epoxy B73-300 Series.
 - 3) Topcoat - Gloss: S-W Acrolon Waterbased Acrolon 100 WB Urethane.
 - e. Tnemec Company, Inc.:
 - 1) Prime Coat: Series 1254 EpoxoBlock WB.
 - 2) Intermediate Coat: Series 27 W.B. Typoxy.
 - 3) Topcoat - Semi-Gloss: Series 287 Enviro-Pox.
 - 4) Topcoat - Gloss: Series 297 Enviro-Glaze.

C. Steel Substrates: Exposed structural steel, rooftop structures, angle lintels and hung plate substrates.

1. Pigmented Polyurethane over Zinc-Rich Primer System:
 - a. Benjamin Moore & Company:
 - 1) Prime Coat: Corotech Organic Zinc Rich Primer V170.
 - 2) Intermediate Coat: Corotech Aliphatic Acrylic Urethane Coating Gloss V500.
 - 3) Corotech Aliphatic Acrylic Urethane Coating Gloss V500.
 - b. Devoe Coatings:
 - 1) Prime Coat: Cathacoat 302H.
 - 2) Intermediate Coat: Bar-Rust 231 Series.
 - 3) Topcoat - Gloss: Devthane 379.
 - c. International Paint LLC:
 - 1) Prime Coat: Cathacoat 302H.
 - 2) Intermediate Coat: Bar-Rust 231 Series.
 - 3) Topcoat - Gloss: Devthane 379 Series.
 - d. PPG Paints:
 - 1) Prime Coat: Amercoat 68HS VOC Zinc Rich Epoxy Primer.
 - 2) Intermediate Coat: Amerlock 2 VOC Epoxy Coating.
 - 3) Topcoat: Amershield VOC Acrylic Polyurethane.
 - e. Sherwin-Williams Company:

- 1) Prime Coat: S-W Zinc Clad XI WB Inorganic Zinc-Rich Coating.
 - 2) Intermediate Coat: S-W Pro Industrial Waterbased Catalyzed Epoxy B73-300 Series.
 - 3) Topcoat: S-W Acrolon Waterbased Acrolon 100 WB Urethane Gloss Enamel.
 - f. Tnemec Company, Inc.:
 - 1) Prime (Shop) Coat: Series 94H2O Hydro Zinc. Refer to applicable Division 05 Section.
 - 2) Intermediate Coat: Series 27 W.B. Typoxy.
 - 3) Topcoat - Gloss: Gold Standard Fluoropolymer Series V1070.
 - D. Galvanized-metal substrates should not be chromate passivated if primers are field applied. If galvanized metal is chromate passivated, consult manufacturers for appropriate surface preparation and primers.
 - E. Galvanized-Metal Substrates:
 1. Pigmented Polyurethane over Epoxy Primer System:
 - a. Benjamin Moore & Company:
 - 1) Prime Coat: Corotech Waterborne Bonding Primer V175.
 - 2) Intermediate Coat: Corotech Aliphatic Acrylic Urethane Coating Gloss V500.
 - 3) Corotech Aliphatic Acrylic Urethane Coating Gloss V500.
 - b. International Paint LLC:
 - 1) Prime Coat: Devran 203.
 - 2) Intermediate Coat: Devthane 379 Series.
 - 3) Topcoat: Devthane 379 Series.
 - c. PPG Paints:
 - 1) Prime Coat: Amerlock 2 VOC.
 - 2) Intermediate Coat: Amerlock 2 VOC.
 - 3) Topcoat: Amershield VOC Acrylic Polyurethane.
 - d. Sherwin-Williams Company:
 - 1) Prime Coat: Pro Cryl Universal Primer B66-1310 or, for high abrasion areas: DTM Wash Primer B71Y00001.
 - 2) Intermediate Coat: Pro Industrial Waterbased Catalyzed Epoxy B73-300 Series.
 - 3) Topcoat: S-W Acrolon Waterbased Acrolon 100 WB Urethane Gloss Enamel.
 - e. Tnemec Company, Inc.:
 - 1) Prime Coat: Series 27 W.B. Typoxy.
 - 2) Intermediate Coat: Series 27 W.B. Typoxy.
 - 3) Topcoat - Gloss: 1080 Endura-Shield.
- ### 3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE
- A. Concrete Substrates, Vertical Surfaces:
 1. Epoxy-Modified Latex System:
 - a. Benjamin Moore & Company:
 - 1) Prime Coat: Super Spec Waterborne Latex Block Filler 160.
 - 2) Intermediate Coat: Epoxy-modified latex, matching topcoat.
 - 3) Topcoat - Semi-gloss: Super Spec HP Acrylic Epoxy Semi-Gloss Catalyzed P43.

- b. Benjamin Moore & Company; Corotech Line:
 - 1) Prime Coat: Corotech Epoxy Block Filler V163.
 - 2) Intermediate Coat: Corotech Waterborne Amine Epoxy Coating V440.
 - 3) Topcoat - Semi-gloss: Corotech Waterborne Amine Epoxy Coating V440.
 - c. International Paint LLC:
 - 1) Prime Coat: Tru-Glaze WB 4015 (squeegee into bugholes).
 - 2) Intermediate Coat: Match topcoat.
 - 3) Topcoat - Semi-Gloss: Tru-Glaze WB 4426.
 - d. PPG Paints:
 - 1) Prime Coat: Pitt Glaze WB 16-90 Epoxy Block Filler.
 - 2) Intermediate Coat: Epoxy-modified latex, matching topcoat.
 - 3) Topcoat - Semi-gloss: Pitt Glaze WB 1 16-510 Series Water Based Pre-catalyzed Acrylic Epoxy.
 - e. Sherwin-Williams Company:
 - 1) Prime Coat: Cement Plex 875 WB Epoxy Block Filler (high moisture areas), or S-W Loxon Block Surfacer, LX01 Series.
 - 2) Intermediate Coat: Epoxy-modified latex, matching topcoat.
 - 3) Topcoat - Gloss: Pro Industrial Water Based Catalyzed Epoxy EG B 73-300Series.
 - f. Tnemec Company, Inc.:
 - 1) Prime Coat: Series 1254 EpoxoBlock WB.
 - 2) Intermediate Coat: Series 27 W.B. Typoxy.
 - 3) Topcoat - Semi-Gloss: Series 287 Enviro-Pox.
- B. CMU Substrates:
- 1. Epoxy-Modified Latex System:
 - a. Benjamin Moore & Company:
 - 1) Super Spec Waterborne Latex Block Filler 160.
 - 2) Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.
 - 3) Topcoat - Semi-gloss: Super Spec HP Acrylic Epoxy Semi-Gloss Catalyzed P43.
 - b. Benjamin Moore & Company; Corotech Line:
 - 1) Prime Coat: Corotech Epoxy Block Filler V163.
 - 2) Intermediate Coat: Corotech Waterborne Amine Epoxy Coating V440.
 - 3) Topcoat - Gloss: Corotech Waterborne Amine Epoxy Coating V440
 - c. International Paint LLC:
 - 1) Prime Coat: Tru-Glaze WB 4015.
 - 2) Intermediate Coat: Matching topcoat.
 - 3) Topcoat - Gloss: Tru-Glaze WB 4428.
 - d. PPG Architectural Coatings, PPG Paints:
 - 1) Prime Coat: Pitt Glaze WB 16-90 Epoxy Block Filler.
 - 2) Intermediate Coat: Epoxy-modified latex, matching topcoat.
 - 3) Topcoat - Semi-gloss: Pitt Glaze WB 16-510 Series Pre-Catalyzed Acrylic Water Based Epoxy.

- e. Sherwin-Williams Company:
 - 1) Prime Coat: Cement Plex 875 WB Epoxy Block Filler (high moisture areas), or S-W Loxon Block Surfacer, A24W200.
 - 2) Intermediate Coat: Epoxy-modified latex, matching topcoat.
 - 3) Topcoat - Gloss: Pro Ind. Water Based Catalyzed Epoxy Gloss B73-300 Series.
 - f. Tnemec Company:
 - 1) Prime Coat: Series 1254 EpoxoBlock WB.
 - 2) Intermediate Coat: Series 27 W.B. Typoxy.
 - 3) Topcoat - Gloss: Series 297 Enviro-Glaze.
- C. Steel Substrates:
- 1. Epoxy-Modified Latex System: Low contact/low traffic areas such as, but not limited to structural steel, overhead decking, pipes, ducts, etc., as scheduled.
 - a. Benjamin Moore & Company:
 - 1) Prime Coat: Corotech Acrylic Metal Primer V110.
 - 2) Intermediate Coat: Corotech Waterborne Amine Epoxy Coating V440.
 - 3) Topcoat: Corotech Waterborne Amine Epoxy Coating V440.
 - b. International Paint LLC:
 - 1) Prime Coat: Devran 203.
 - 2) Intermediate Coat: Tru-Glaze WB 4426.
 - 3) Topcoat: Tru-Glaze WB 4428.
 - c. PPG Paints:
 - 1) Prime Coat: Amerlock 2 VOC Epoxy
 - 2) Intermediate Coat: Amerlock 2 VOC Epoxy
 - 3) Topcoat - Gloss: Amerlock 2 VOC Epoxy
 - d. Sherwin-Williams Company:
 - 1) Prime Coat: S-W Pro Cryl Universal Metal Primer B66-310 Series.
 - 2) Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.
 - 3) Topcoat - Gloss: Pro Ind. S-W Water Based Catalyzed Epoxy Gloss B73-300 Series.
 - e. Tnemec Company, Inc.:
 - 1) Prime Coat: Series 27 W.B. Typoxy.
 - 2) Intermediate Coat: Series 27 W.B. Typoxy.
 - 3) Topcoat - Gloss: Series 297 Enviro-Glaze.
 - 2. Pigmented Polyurethane over Zinc-Rich and Epoxy System: High contact/high traffic areas such as, but not limited to doors, railings, frames, pipes, etc.
 - a. Benjamin Moore & Company:
 - 1) Prime Coat: Corotech Organic Zinc Rich Primer V170.
 - 2) Intermediate Coat: Corotech Polyamide Epoxy Primer V150.
 - 3) Topcoat - Gloss: Corotech Aliphatic Acrylic Urethane Coating Gloss V500.
 - b. International Paint LLC:
 - 1) Prime Coat: Catha-Coat 302H.
 - 2) Intermediate Coat: Bar-Rust 231 Series.
 - 3) Topcoat - Gloss: Devthane379 Series.
 - c. PPG Paints:

- 1) Prime Coat: Amercoat 68HS VOC Zinc Rich Epoxy Primer.
 - 2) Intermediate Coat: Amerlock 2 VOC Epoxy Coating.
 - 3) Topcoat: Amershield VOC Acrylic Polyurethane.
- d. Sherwin-Williams Company:
- 1) Prime Coat: S-W Zinc Clad XI WB Inorganic Zinc-Rich Coating.
 - 2) Intermediate Coat: S-W Acrolon Waterbased Acrolon 100 WB Urethane.
 - 3) Topcoat: S-W Acrolon Waterbased Acrolon 100 WB Urethane.
- e. Tnemec Company, Inc.:
- 1) Prime (Shop) Coat: Series 94H2O Hydro-Zinc. Refer to applicable Division 05 Sections.
 - 2) Intermediate Coat: Series 287 Enviro-Pox.
 - 3) Topcoat - Gloss: Series 297 Enviro-Glaze.
- D. Galvanized-metal substrates should not be chromate passivated if primers are field applied. If galvanized metal is chromate passivated, consult manufacturers for appropriate primers.
- E. Galvanized-Metal Substrates:
1. Epoxy over Epoxy Primer System: Low contact/low traffic areas such as, but not limited to structural steel, overhead decking, pipes, ducts, etc., as scheduled.
 - a. Benjamin Moore & Company:
 - 1) Prime Coat: Corotech Polyamide Epoxy Primer V150.
 - 2) Intermediate Coat: Epoxy, matching topcoat.
 - 3) Topcoat Gloss: Corotech Polyamide Epoxy V400.
 - b. PPG Paints:
 - 1) Prime Coat: Amerlock 2 VOC Epoxy
 - 2) Intermediate Coat: Amerlock 2 VOC Epoxy
 - 3) Topcoat - Gloss: Amerlock 2 VOC Epoxy
 - c. International Paint LLC:
 - 1) Prime Coat: Devran 203.
 - 2) Intermediate Coat: Devran 224V.
 - 3) Topcoat: Devran 224V.
 - d. Tnemec Company, Inc.:
 - 1) Prime Coat: Series 27 W.B. Typoxy.
 - 2) Intermediate Coat: Series 27 W.B. Typoxy.
 - 3) Topcoat Gloss: Series Series 297 Enviro-Glaze.
 2. Pigmented Polyurethane over Epoxy Primer System: High contact/high traffic areas such as, but not limited to doors, frames, railings, pipes, etc.
 - a. Benjamin Moore & Company:
 - 1) Prime Coat: Corotech Organic Zinc Rich Primer V170.
 - 2) Intermediate Coat: Corotech Polyamide Epoxy Primer V150.
 - 3) Topcoat Gloss: Corotech Aliphatic Acrylic Urethane Coating Gloss V500.
 - b. International Paint LLC:
 - 1) Prime Coat: Devran 203.
 - 2) Intermediate Coat: Devran 203.
 - 3) Topcoat - Gloss: Devthane379 Series.
 - c. PPG Architectural Coatings, PPG Paints:

- 1) Prime Coat: Amerlock 2 VOC Epoxy
 - 2) Intermediate Coat: Amerlock 2 VOC Epoxy
 - 3) Topcoat - Gloss: Amershield VOC Acrylic Polyurethane
 - d. Sherwin-Williams Company:
 - 1) Prime Coat: DTM Wash Primer B71Y1.
 - 2) Intermediate Coat: S-W Acrolon Waterbased Acrolon 100 WB Urethane.
 - 3) Topcoat - Gloss: Acrolon Waterbased Acrolon 100 WB Urethane.
 - e. Tnemec Company, Inc.:
 - 1) Prime Coat: Series 27 W.B. Typoxy.
 - 2) Intermediate Coat: Series 27 W.B. Typoxy.
 - 3) Topcoat - Gloss: Series 297 Enviro-Glaze.
- F. Gypsum Board Substrates:
1. Epoxy-Modified Latex System:
 - a. Benjamin Moore & Company:
 - 1) Prime Coat: Insl-X Aqua Lock Plus AQ-0400.
 - 2) Intermediate Coat: Pre-Catalyzed Waterborne Wall Epoxy Semi-Gloss V341.
 - 3) Topcoat Pre-Catalyzed Waterborne Wall Epoxy Semi-Gloss V341.
 - b. International Paint LLC:
 - 1) Prime Coat: Tru-Glaze WB 4030.
 - 2) Intermediate Coat: Match topcoat.
 - 3) Topcoat - Semi-Gloss: Tru-Glaze 4426.
 - c. PPG Paints:
 - 1) Prime Coat: SPEEDHIDE Zero 6-4900XI Interior Latex Sealer Quick-Drying.
 - 2) Intermediate Coat: Epoxy-modified latex, matching topcoat.
 - 3) Topcoat - Semi-Gloss: Pitt Glaze WB 16-510 Series Pre-catalyzed Water Based Acrylic Epoxy.
 - d. Sherwin-Williams Company:
 - 1) Prime Coat: Pro Mar 200 Zero VOC Interior Latex Primer.
 - 2) Intermediate Coat: Epoxy-modified latex, matching topcoat.
 - 3) Topcoat - Gloss: Pro Ind. Water Based Catalyzed Epoxy B73-300 Series.
 - e. Tnemec Company, Inc.:
 - 1) Prime Coat: Series 151-1051 Elasto-Grip.
 - 2) Intermediate Coat: Series W.B. Typoxy.
 - 3) Topcoat - Semi-Gloss: Series 287 Tneme-Glaze.

END OF SECTION

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SECTION 10 14 00 - SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Room and door signs.

1.2 DESIGN REQUIREMENTS - INTERIOR SIGNS

A. Permanent Rooms and Spaces:

1. Provide signs identifying each room at each door.
2. Type Styles:
 - a. Must be upper case and sans serif.
 - b. Must have a width to height ratio of between 3:5 and 1:1.
 - c. Must have a stroke width to height ratio of between 1:5 and 1:10.
3. Tactile and Braille Characters: Characters raised a minimum of 1/32 inch and accompanied by Grade 2 braille.
4. Slot for removable room name capable of containing two lines of text.
5. Character Height: Tactile characters must be between 5/8 inch and 2 inches in height.
6. Pictograms (Symbols), if specified:
 - a. Minimum of a 6 inch high field or background; must be supplemented by upper case tactile descriptive verbiage and Grade 2 braille below pictogram.
 - b. No other graphic can invade the pictogram field.
 - c. Pictogram itself is not required to be tactile.
 - d. Provide pictogram and descriptive verbiage accompanied by Grade 2 braille at locations required.
7. Finish and Contrast:
 - a. Matte (non-glare) characters and background; minimum contrast of 70 percent.
 - b. Light characters on dark background or dark characters on light background are acceptable.
8. Mounting Conditions:
 - a. Mount 60 inches from finish floor to baseline of highest tactile letter on latch side of door.
 - b. Where no wall space is provided at the latch side of the door, place on nearest adjacent wall so that a person can approach to within 3 inches of signage without protrusions or swing of door.

B. Direction and Informational:

1. Type Styles:
 - a. May be upper and lower case and sans serif.
 - b. Shall have a width to height ratio of between 3:5 and 1:1.
 - c. Shall have a stroke width to height ratio of between 1:5 and 1:10.
2. Tactile and Braille Characters: Not required for Type 2 signage.
3. Character Height: Characters shall be sized on viewing distance.
4. Pictograms (Symbols), if specified:
 - a. No tactile requirement.
 - b. Provide pictogram at locations designated in Signage Schedule and Drawings.

5. Finish and Contrast:
 - a. Matte (non-glare) characters and background; minimum contrast of 70 percent.
 - b. Light characters on dark background or dark characters on light background are acceptable.
6. Mounting Conditions:
 - a. Mount 60 inches from finish floor to baseline of highest tactile letter on latch side of door.
 - b. Where no wall space is provided at the latch side of the door, place on nearest adjacent wall so that person can approach to within 3 inches of signage without protrusions or swing of door.
- C. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, sign types, lettering font, tactile designations, foreground and background colors, locations, overall dimensions of each sign and method of attachment.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule along with the room number that will appear on the sign.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips of the manufacturers full range of colors.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled in name groups.
- C. Store tape adhesive at normal room temperature.

PART 2 PRODUCTS

2.1 SIGNAGE FABRICATION

- A. Available Manufacturers:
 1. Best Sign Systems, Inc.
 2. Mohawk Sign Systems, Inc.
 3. Bayuk Graphic Systems, Inc., Parkesburg, Pennsylvania.
 4. Digital Color Graphics, Pittsburgh, Pennsylvania.
 5. Supersine Company.
- B. Fabrication Method:
 1. Plaque assembly to be plastic laminate construction; plastic laminate to be impervious to most acids, alkalies, alcohol, solvents, abrasives and boiling water; plastic laminate to be non-static, fire-retardant, and self extinguishing.

2. Approximately 0.080-inch thick non-glare matte acrylic face laminated to approximately 0.080-inch thick acrylic back plate with filler to create windows for inserts, if so indicated.
3. Non-tactile graphics to be subsurface or second surface applied signs; surface-applied graphics are not acceptable.
4. Painted surfaces will not be accepted.
5. Polycarbonate (0.03 inch thick) window inserts, if applicable; painted subsurface to match sign.
6. Tactile Methods:
 - a. Option 1: Tactile Copy Material (where designated): Individual plastic letters or characters of one solid color and chemically bonded by the use of a high strength solvent within a matched routed depression in sign face to create graphics which are raised a minimum of 1/32 inch from the face of sign; tactile characters 5/8 inch to 2 inches in height as required by Architect.
 - b. Option 2: Tactile Copy (where designated): Produced by blasting the laminate assembly removing the background material, and raising the characters and braille; the characters and braille are part of the original outer laminate color and do not require painting.
7. Braille (if applicable): Grade 2 braille engraved into face of sign.
8. Mechanically fasten plaque assembly to wall by use of a backplate, which will be secured to the outer assembly.
9. Corners as indicated; sides can be beveled or flat.
10. Colors to be selected by Architect, which include custom fabrications based on manufacturer's capabilities.

2.2 ACCESSORIES

- A. Exposed Screws: Chrome plated; tamper-proof.
- B. Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions after surfaces are finished.
- B. Install neatly, with horizontal edges level, plumb and true, and in correct relation to adjoining Work.
- C. Locate signs where indicated:
 1. If no location is indicated obtain Owner's instructions.
- D. Protect from damage until Substantial Completion; repair or replace damaged items.

3.3 CLEANING

- A. Wash surfaces following installation.

END OF SECTION

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SECTION 10 21 13.19 - PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal screens.

1.2 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2019.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- C. Product Data: Provide data on panel construction, hardware, and accessories.
- D. Samples: Submit two samples of partition panels, 3 x 3 inch in size illustrating panel finish, color, and sheen.
- E. Test Reports: Indicating compliance with NFPA 286.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design: Scranton Products - Hiny Hiders.
- B. Bradley Corporation.
- C. Hadrian.
- D. Global Partitions.

2.2 COMPONENTS

- A. Toilet Compartments: Solid molded high density polyethylene (HDPE) plastic panels, doors, and pilasters, floor-mounted unbraced.
 - 1. Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 2. Recycled content products are preferred.
 - 3. NFPA 286 Compliant.
 - 4. Color: To be selected from manufacturer's entire range.
- B. Door and Panel Dimensions:
 - 1. Thickness: 1 inch.
 - 2. Door Width: 24 inch.
 - 3. Door Width for Handicapped Use: 36 inch, out-swinging.
 - 4. Height: Manufacturer's standard not less than 55 inch.
 - 5. Thickness of Pilasters: 1 inch.

- C. Urinal Screens: Wall mounted with continuous panel brackets and pilaster anchored to floor.
 - 1. Maximum dimension from finished floor to bottom of urinal screen: 12 inches.
 - 2. Minimum dimension from finished floor to top of urinal screen: 60 inches.
 - 3. Minimum depth of urinal screen to be 18 inches; or from finished wall to a minimum of 6 inches beyond the outermost front lip of the urinal, whichever is greater.

2.3 ACCESSORIES

- A. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails: Hollow anodized aluminum tube, 1 x 1-5/8 inch size, with anti-grip strips and cast socket wall brackets.
- C. Wall and Pilaster Brackets:
- D. Wall Brackets: Continuous type, polished stainless steel.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
 - 2. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.
- F. Hardware: Polished stainless steel:
 - 1. Continuous hinges self-closing; stainless steel.
 - 2. Door Latch: Slide type with exterior emergency access feature.
 - a. Accessible stall door to be equipped with a slide latch that does not require gripping or twisting and shall be slotted to permit emergency access
 - 3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 4. Coat hook with rubber bumper; one per compartment, mounted on door.
 - 5. Provide door pull for outswinging doors.
 - a. Provide two door pulls (one each side) at accessible compartments to comply with ADA requirements.
- G. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-polymer doors and partitions.
- H. Provide wall stop at out-swinging doors where applicable.

2.4 FABRICATION

- A. Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions.
- B. Make provisions for setting and securing continuous head rail at top of each pilaster.
- C. Provide shoes at pilasters to conceal supports and leveling mechanism.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.2 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.3 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.
- D. Adjust latching hardware for proper operation.

END OF SECTION

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SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Accessories for toilet rooms and utility rooms.
- B. Grab bars.

1.2 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service 2015a (Reapproved 2019).
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- C. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium 2017.
- D. ASTM C1036 - Standard Specification for Flat Glass 2016.
- E. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

1.4 COORDINATION

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Keys: Provide 2 keys for each accessory to Owner; master key all lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- F. Adhesive: Two component epoxy type, waterproof.
- G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- H. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.2 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

- B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.
- C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.

2.3 TOILET ROOM ACCESSORIES

- A. The design for each accessory is based on products indicated on the Drawings.

2.4 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 - 1. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
 - 2. Length: Manufacturer's standard length for number of holders/hooks.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that field measurements are as indicated on drawings.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.4 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.2 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers 2017, with Errata (2018).

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. JL Industries, Inc: www.jlindustries.com.
- B. Larsen's Manufacturing Co: www.larsensmfg.com.
- C. Potter-Roemer: www.potterroemer.com.

2.2 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Dry Chemical Type Fire Extinguishers: Steel tank, with pressure gage.
 - 1. Class Multi-purpose 4-A:60-B:C.
 - 2. Size 10 pounds.
 - 3. Finish: Baked enamel, color as selected.

2.3 FIRE EXTINGUISHER CABINETS

- A. Description: Formed steel box with aluminum trim and door.
 - 1. Fire-Rated Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Cabinet Configuration: Recessed type.
 - 1. Size to accommodate accessories.
 - 2. Projected Trim: Returned to wall surface, with 1/4 to 5/16 inch projection, and 1-3/4 inch wide face.
 - 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- C. Door: Reinforced for flatness and rigidity. Hinge doors for 180 degree opening with continuous piano hinge. Provide roller type catch.
- D. Door Glazing: Float glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.

1. Design: Vertical Duo.
 - E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
 - F. Weld, fill, and grind components smooth.
 - G. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.
 - H. Finish of Cabinet Interior: White colored enamel.
- 2.4 ACCESSORIES
- A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers in cabinets.

END OF SECTION

SECTION 10 51 26 - PLASTIC LOCKERS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Solid plastic lockers.
- B. Locker benches.

1.2 RELATED REQUIREMENTS**1.3 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- C. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2019.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. Solid Plastic Lockers:
 - 1. Columbia Lockers, a division of PSiSC; PolyLife Lockers: www.psisc.com/#sle.
 - 2. Scranton Products; Duralife Lockers: www.scrantonproducts.com/#sle.
 - 3. General Partitions; Solid Plastic HDPE Lockers.

2.2 SOLID PLASTIC LOCKERS

- A. Accessibility: Comply with ICC A117.1 and ADA Standards.
- B. Lockers: Factory assembled, made of solid plastic panels, tested in accordance with NFPA 286, homogenous color throughout.
 - 1. Doors: Full overlay without frame.
 - 2. Door Color: To be selected by Architect.
 - 3. Body Color: Manufacturer's standard white or light color.
- C. Component Thicknesses:
 - 1. Doors: 1/2 inch minimum thickness.
 - 2. Locker Body: Tops, bottoms, backs, and shelves 3/8 inch minimum.
 - 3. End Panels and Filler Panels: 1/2 inch minimum thickness.
 - 4. Sloped Tops: 1/2 inch minimum thickness.
 - 5. Toe Kick Plates: 1/2 inch minimum thickness.
- D. Hinges: Full height of locker, manufacturer's standard heavy duty type.
- E. Coat Hooks: Reinforced nylon.

- F. Number Plates: Provide rectangular shaped aluminum plates. Form numbers in a block font style with ADA designation, in contrasting color.

2.3 LOCKER BENCHES

- A. Tops: Clear hardwood tops, 1-1/4 inches thick.
- B. Sizes:
 - 1. Typical: 8 inches wide by length shown on drawings.
 - 2. ADA Location: 20 inches wide by 42 inches long with back where not located against a wall.
- C. Supports: Steel pipe standards spaced not more than 6 feet on center, provide doubles at ADA bench.
- D. Overall Height: 17-1/2 inches.
- E. Finish:
 - 1. Wood: Three coats of polyurethane.
 - 2. Steel: Primer and two coats of enamel; color to match lockers.
- F. Attach each standard to top by screws and anchor to floor by two suitable anchors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Install end panels, filler panels, and sloped tops.
- E. Install fittings if not factory installed.
- F. Replace components that do not operate smoothly.

3.3 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 11 24 23 - FALL PROTECTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: This Section specifies design, supply and installation of Fall Protection systems if such systems are not provided with the roof ladder.

1.2 REFERENCES

- A. American Institute of Steel Construction (AISC).
1. AISC S342L, Load and Resistance Factor Design Specification for Structural Steel Buildings (including Supplement No.1).
- B. Aluminum Association (AA).
1. AA DAF 45, Designation System for Aluminum Finishes.
 2. AA ADM-1, Aluminum Design Manual.
- C. American Society of Mechanical Engineers (AMSE).
1. ASME A120.1, Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance.
- D. American National Standards Institute / International Window Cleaning Association (ANSI/IWCA).
1. ANSI/IWCA I-14.1, Window Cleaning Safety Standard.
- E. American Welding Society (AWS).
1. AWS D1.2/D1.2M, Structural Welding Code - Aluminum.
 2. AWS D1.1/D1.1M, Structural Welding Code—Steel.
- F. ASTM International (ASTM).
1. ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 2. ASTM A167, Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip.
 3. ASTM A276, Standard Specification for Stainless Steel Bars and Shapes.
 4. ASTM A492 Standard Specification for Stainless Steel Rope.
 5. ASTM B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- G. International Code Council (ICC).
1. International Building Code.
- H. Occupational Safety and Health Administration (OSHA).
1. OSHA 1910, Subpart D, Walking and Work Surfaces.
 2. OSHA 1910, Subpart F, Appendix C, Personal Fall Arrest Systems.
 3. OSHA Ruling on Window Cleaning by Bosun's Chair.
 4. OSHA 1910.66 Subpart F, Powered Platforms.
- I. National Roofing Contractor's Association (NRCA)
1. The NRCA Roofing and Waterproofing Manual, Fifth Edition.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate information on shop drawings as follows:
1. Submit shop drawings showing complete layout and configuration of fall protection equipment including components and accessories.

2. Indicate design and fabrication details, hardware, and installation details.
3. Include installation and rigging instructions and:
 - a. Required restrictive working usage and general safety notes.
 - b. Non-restrictive working usage and general safety notes.
4. Ensure Shop Drawings are reviewed by Engineer licensed in State of Maryland and submit calculations and test reports to Architect.
- B. Submit product data, including manufacturer's technical data sheet, for specified products.
- C. Quality Assurance:
 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
 2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
 3. Manufacturer's installation instructions.
- D. Submit 1-year standard manufacturer warranty documents specified.
- E. Operation and Maintenance Data: Submit Operation and Maintenance data for installed products.
 1. Include:
 - a. Manufacturer's instructions covering maintenance requirements and parts catalog giving complete list of repair and replacement parts with cuts and identifying numbers.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 1. Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
 2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction and approving application method.
- B. Regulatory Requirements.
 1. Comply with International Building Code (IBC)
 2. Comply with OSHA regulations as follows:
 - a. 1910, Subpart D, Walking and Working Surfaces.
 - b. Appendix C to 1910 Subpart F, Personal Fall Arrest Systems.
- C. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
 1. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.
- B. Storage and Protection:
 1. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.6 SEQUENCING

- A. Sequence with other Work and Comply with window washing equipment manufacturer's written recommendations for sequencing construction operations.

1.7 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under Contract Documents.
- B. Warranty: Commencing on date of substantial completion set by Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturer: Pro-Bel Group of Companies, Phone: (905) 427-0616, USA Toll Free: (800) 461-0575, Fax: (905) 427-2545, E-mail: <mailto:info@pro-belgroup.com>, www.pro-belgroup.com

2.2 DESIGN PERFORMANCE REQUIREMENTS

- A. Design system fall arrest safety anchors and equipment supports to AISC S342L (including supplement No.1) and ANSI/IWCA I-14.1, and as follows:
 - 1. Comply with OSHA 1910, Subpart F, Appendix C.
 - 2. Fall Arrest Safety Anchors:
 - a. Fall arresting force safety factor of 2 to 1 without permanent deformation: 1800 lbs (8.0 kN) minimum.
 - b. Fall arrest force against fracture or detachment: 5,000 lbs (22.4 kN) minimum.

2.3 ANCHORS

- A. Safety U-bars: Stainless steel to ASTM A276, Type 304 with 35 Ksi (240 MPa) minimum yield strength.
 - 1. U-bar: 0.75 inches (19 mm) minimum diameter material with 1.5 inches (38 mm) eye opening.
- B. Hollow Steel Section (HSS) Piers: Mild steel, Type 300W with 50 Ksi (350 MPa) minimum yield strength, hot dipped galvanized to ASTM A123/A123M
 - 1. Wall thickness to suit application.
- C. Plate and other sections: Mild steel, Type 300W with 44 Ksi (300 MPa) minimum yield strength, hot dipped galvanized to ASTM A123/A123M
 - 1. Wall thickness to suit application.
- D. Seamless Spun Aluminum Flashing (for Roof Anchors): To AA ADM-1 Type 6061-T6 alloy and to ASTM B221.
 - 1. Deck flange flashing: To NRCA Roofing and Waterproofing Manual recommendations.
 - 2. Manufacturers standard Aluminum Deck Flange Flashing.
- E. Miscellaneous Bolts, Nuts and Washers: Stainless steel to ASTM A276, Type 304 with 35 Ksi (240 MPa) minimum yield strength.

2.4 SOURCE QUALITY CONTROL

- A. Ensure Fall Protection equipment components and materials are from single manufacturer.

PART 3 EXECUTION

3.1 INSTALLERS

- A. Provide experienced and qualified technicians to carry out erection, assembly and installation of fall protection and suspended maintenance equipment system.
- B. Do steel welding to AWS D1.2/D1.2M.
- C. Do aluminum welding to AWS D1.1/D1.1M.

3.2 MANUFACTURERS INSTRUCTIONS

- A. Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions and manufactures technical data sheets.

3.3 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Verify that substrate conditions are acceptable for product installation in accordance with manufacturer's instructions prior to installation.
 - 2. Inform Architect of unacceptable conditions immediately upon discovery.
 - 3. Proceed with installation only after unacceptable conditions have been remedied.

3.4 PREPARATION

- A. Ensure structural steel to receive safety anchors has adequate bearing surface as indicated on shop drawings.

3.5 INSTALLATION

- A. Coordinate fall protection work with work of other trades, for proper time and sequence to avoid construction delays.
- B. Install fall protection equipment plumb and level in accordance with manufacturer's written instructions.
- C. Mechanically fasten anchors in accordance with manufacturer's recommendations.
- D. Accurately fit and align, securely fasten and install free from distortion or defects.
- E. Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal and vandalism.

3.6 FIELD QUALITY CONTROL

- A. When necessary have the manufacture assist in installation.

3.7 FINAL CLEANING

- A. Upon completion, remove surplus and excess materials, rubbish, tools and equipment.

3.8 PROTECTION

- A. Protect installed product from damage during construction.
- B. Make good damage to adjacent materials caused by fall protection equipment installation.

END OF SECTION

SECTION 11 30 13 - APPLIANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Appliances.

1.2 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory Current Edition.

1.3 QUALITY ASSURANCE

A. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

PART 2 PRODUCTS

2.1 APPLIANCES

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor built-in equipment in place.

3.3 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.4 CLEANING

A. Remove packing materials from equipment and properly discard.

B. Wash and clean equipment.

END OF SECTION

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SECTION 12 35 50 - INSTITUTIONAL CASEWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes plastic laminate casework and related items including, but not limited to, countertops, back splashes, filler panels, and scribe pieces, as necessary for complete installation.
 - 1. Related Sections include the following:
 - a. Division 8 Section "Resilient Flooring" for resilient wall base.
 - b. Division 25 Sections for sinks and fittings in countertops.
 - c. Division 26 Sections for electrical fittings and outlets.

1.2 SUBMITTALS

- A. Product Data: For each type of educational casework unit specified.
- B. Shop Drawings: Include plan layout, elevations, ends, cross-sections, location and type of service fittings, required clearances, methods of assembly and reassembly, design and arrangements.
- C. Samples for Selection: Manufacturer's color charts and material samples showing full range of colors, textures, and finishes. Submit a basic container unit with shelves, dividers, base and hardware. Samples must have cutaways to clearly demonstrate materials, construction, workmanship, and finish.
- D. Sample for Verification: Submit full size sample of typical cabinet which may be incorporated into the Work if in good condition and approved by Architect. Owner may take one cabinet unit off site for deconstructive testing. Cabinet will be selected at random. Replace unit at no extra cost to Owner.
- E. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.
- F. Maintenance Data: For educational casework to include in maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Forest Certification: Provide wood products made from forests certified by an FSC-accredited certification body. All non-FSC wood in assemblies with FSC-certified wood shall meet the FSC Controlled Wood (CW) criteria.
- B. Installer Qualifications: Engage a firm specializing in installation of casework for a minimum of 5 years and acceptable to manufacturer.
- C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Unless modified by notation on Drawings, or otherwise specified, catalog description for designated product constitutes requirements for each product and establishes a standard of design and quality for materials, construction and workmanship. Other acceptable manufacturers' laboratory casework of similar sizes, similar door and drawer configurations, and complying with the Specifications will be accepted

- D. Single Source Responsibility: To assure coordinated unit design, all items in each room or space, other than appliances and special equipment specified in other Sections, shall be products of one manufacturer to the greatest extent possible.
- E. Quality Standard: Except as otherwise indicated, comply with the following standards:
 - 1. AWI Cabinet Quality Standard: AWI Section 1600.
 - 2. AWI Countertop Quality Standard: AWI Section 400C.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Administrative Requirements."

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating educational casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of educational casework that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: 3 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis-of-Design: Stevens.
 - 2. Case Systems, Inc.
 - 3. The Mastercraft Woodworking Company.
 - 4. TMI Systems Design Corporation.
 - 5. Paragon Casework.

2.2 MATERIALS

- A. Composite wood installed within the building interior: Comply with California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM), Phase II for ultra-low-emitting formaldehyde (ULEF) resins or containing no added formaldehyde resins.
- B. High Pressure Decorative Laminate: NEMA LD3, grades as indicated.
 - 1. Plastic Laminate: Vertical General Purpose Grade (VGS), 0.030-inch nominal thickness; for exterior cabinet surfaces, interiors of open cabinets, and underside of wall cabinets.
 - 2. Plastic Laminate Balancing Sheet: Cabinet Liner Grade (CLS), 0.020-inch nominal thickness, white high-pressure cabinet liner, for balancing exterior laminate surfaces.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Formica Corporation.
- b. Nevamar; International Paper; Decorative Products Div.
- c. Wilsonart International; Div. of Premark International, Inc.
2. Color: Basis-of-Design - Beigewood 7850-60 (Matte) from Wilsonart.
3. End panels may match face or may be a color as selected from manufacturer's standard finishes and colors.
4. A maximum total of 12 different casework colors will be selected for this Project. All exposed exterior elements including edges, door and cabinet sides, and exposed backs shall be available in matching color.
- D. Pressure Fused Laminate: Melamine resin impregnated, 90 gram PSM minimum, thermofused to core under pressure, complying with NEMA LD3 VGS and NEMA LD3 CLS standards.
 1. Provide white pressure fused laminate for cabinet interiors behind doors and drawers.
 2. Provide balanced construction at all concealed surfaces with thermofused melamine. Unsurfaced coreboard or simple backers will not be accepted.
- E. Plywood complying with DOC PS 1.
- F. Hardboard:
 1. Hardboard shall meet or exceed Commercial Standards CS-251 and Federal Specifications LLL-B-00810.
 2. Tempered Hardboard 1/4 inch thick, smooth both sides.
 3. Hardboard exposed one side to be 1/4 inch thick, prefinished in putty color to match cabinet interior. Opposite face prefinished with neutral color balance coating.
- G. Edging Materials: Comply with the following:
 1. Exposed Exterior Cabinet Edges, Interior Dividers, Drawer Bodies, and Shelves: Banded with matching material, resistant to chipping, cracking, and high impact, applied with waterproof hot melt adhesive.
 2. Door and Drawer Front Edges: Banded with contrasting or matching PVC extrusion, 3 mm thick, resistant to chipping, cracking, and high impact, applied with waterproof hot melt adhesive, and shaped to provide radiused edges and corners.
 3. Color selection for PVC edging will be made at a later date; Architect reserves the right to select colors manufactured and offered by Woodtape Edge Banding (at no additional cost to the Owner), when a standard selection offered by the casework manufacturer does not provide a suitable color in the Architect's opinion.
- H. Hardware:
 1. Hinges: Hinges fully concealed from view when door is in closed position and shall permit 176-degree door swing. Hinge crank of heavy duty steel with a concealed integral self-closing spring mechanism. Hinge bosses of heavy duty diecast steel. Nylon expansion inserts to be provided in door for positive screw attachment. Hinge shall incorporate mounting features providing three-dimensional adjustment. Hinges to have lifetime guarantee as warranted by manufacturer. Doors less than 48 inches in height with 2 hinges per door, doors 48 to 63 inches in height with 3 hinges per door and all doors in excess of 63 inches with 4 hinges per door.
 2. Wire Pulls: Stainless steel, accurately positioned on door and drawer front with #8-32 screws.
 3. Door Catch: Heavy duty, spring-loaded, large roller type. Each door with a single catch mounted at the bottom edge. All mobile cabinets and doors over 48 inches high with a catch at both top and bottom of door.

4. Catch Strike Plate: Injection molded nylon, almond color, with integral molded engagement ridge. Strike plate to also provide a wide face bumper insuring a positive door stop.
 5. Hanger Rods: 1-inch diameter heavy gage plated tubing, securely affixed in cabinet with injection molded rod sockets.
 6. Drawer and Slide-Out Shelf Slides: Nylon roller steel slides to insure quiet, smooth operation. 100-lb load rating with built-in drawer stop and self-close feature in the last 1-inch of travel.
 7. File Drawer Slides: Full extension steel slides with ball bearing nylon rollers. 100-lb. load rating.
 8. Locks: Cylinder type, diecast, with 5 disc tumbler mechanism. Each lock to be provided with a milled brass key with keying options of keyed alike, keyed different, and master keyed locks, as selected by Owner. Provide locks on all cabinet doors and drawers, except sink and fumehood base cabinets.
 9. Grommets: Plastic or metal, 1.5-inch-diameter, placed at each computer station.
- I. Adjustable Shelf Support System:
1. Support Clips for Adjustable Shelves: 3/4-inch-and 1-inch-thick, injection molded nylon, incorporating integrally molded lock tabs to retain shelf from tipping or inadvertently being lifted out. Support clip to have double pin engagement into precision bored hole pattern in cabinet vertical members, with molded ridge in the clip body to provide additional pressure against edge of shelving and to maintain positive pin engagement. Clip shall be designed to provide means to permanently attach shelf to support clips. Static test load must exceed 200-lb per clip.
 2. Vertical and Horizontal Shelf Dividers: 1/4-inch-thick, fully adjustable and retained with injection molded nylon support clip designed to trap divider to eliminate inadvertent lift out.
 3. Adjustable Shelves and Dividers: Adjustable at 1.25 inches o.c. through full height of compartment.
- J. Wardrobe Clothes Pole: 1-1/16-inch chrome steel rod – LH-362.
- K. Wardrobe Clothes Pole Socket: Knappe & Vogt #734 Flange Chrome.
- L. Coat Hooks:
1. Single coat hooks - HEWI No. 520.60.1 ABS plastic, color to be selected by Architect from manufacturer's full range.
 2. Double coat hooks - HEWI 520.50.2 ABS plastic, color to be selected by Architect from manufacturer's full range.
 3. Ceiling hooks - HEWI 513 ABS plastic, color to be selected by Architect from manufacturer's full range.
- M. Hangers: Captive and removable wood or metal; 17-inch.
- N. Recycled Content: Provide particleboard and MDF with minimum 80 percent recycled content.
- 2.3 COUNTERTOPS
- A. Reference Section 12 36 00 Countertops.
- 2.4 FABRICATION, GENERAL
- A. Cabinet Construction: High-pressure plastic laminate surface finish; flush overlay type door/drawer style.
- B. Chemical Content: All materials used shall be relatively nontoxic when exposed to heat or flame.

- C. Wall Hung Units: When mounted on a wall and loaded with 25 psf on all horizontal surfaces, units shall resist a lateral force applied at the bottom of the cabinet parallel to the long dimension of the cabinet of 300 lbs without failure. Each wall hung unit shall safely support a uniform load of 600 lbs.
- D. Storage units with or without doors shall be able to have shelves and/or vertical dividers rearranged within one or more units of same size without defacing interior of unit.

2.5 FABRICATION, CABINETS

- A. Drawers:
 - 1. Drawers: Full box body design with a separate front; body sides and ends minimum 5/8-inch medium density fiberboard with almond color melamine laminate faces and matching almond color PVC top edges; bottoms minimum 1/4-inch thick medium density fiberboard with almond color facing.
 - 2. Corner Joints: Interlocking dowel pin design, with 8mm diameter dowel pins inserted into drawer ends and fitted into matching hole patterns in drawer sides. Bottoms to be let into grooves all four sides; all joints glued and bottoms shall have additional mechanical fasteners; drawers to operate on mechanical slides as separately described.
 - 3. Separate drawer front, surfaced and edges as described, attached to drawer body with no less than 4 screws through front side.
- B. Solid Hinged Doors: 3/4-inch thick plywood core, balanced construction laminate faces. Surfacing, edging and hinges as separately described.
- C. Solid Sliding Doors: 3/4-inch thick plywood core, balanced construction laminate faces. Each door with 2 nylon rollers mounted in bottom of door panel, and with door operating in aluminum top and bottom tracks. Surfacing and edging as separately described.
- D. Sliding Display Doors: Constructed of 1/4-inch thick, distortion free glazing sheets. Outer edge to have full length aluminum pull channel for strength. Doors must be accurately sized for easy movement in upper and lower extruded aluminum guide channels.
- E. Adjustable Shelves: Shelves less than 36 inches in length shall be 3/4 inches thick. Shelves 36 inches long and over, and all adjustable shelves in wall cabinets and bookcases shall be 1 inch thick. Shelves shall be constructed of plywood with almond color melamine laminate surfaces. Leading edge of shelf finished with a high impact, rigid PVC extrusion, almond in color to match shelf surface and cabinet interior. Exposed surfaces of open shelving without doors shall be finished with plastic laminate.
- F. Frame Rails Between Drawers: Full cabinet length, 3/4 inches thick by 3-1/2 inches wide, pinned, and fastened into cabinet sides. Front leading edge to be edged as separately described.
- G. Tote Trays: High impact polystyrene with smooth edges. Provide each tray with a card holder. Suspend tote trays from rails securely attached to cabinet partitions and sides.

2.6 FABRICATION, FIXED CASEWORK (BASE, WALL, HUTCH, AND TALL UNITS)

- A. Corner Joints: Incorporate fluted hardwood dowel pin construction, factory glued and clamped under pressure to assure rigid loadbearing corner joints.
- B. Cabinet Ends: 3/4-inch-thick panels of balanced construction, precision bored for fluted hardwood dowel pins installed in horizontal cabinet members. Base and tall units with one piece end panels continuous to floor for added load capability. Unexposed ends with laminate backing sheet.

- C. Cabinet Bottoms and Tops: 3/4-inch-thick panels of balanced construction for base and tall units. Precision bore panels to receive fluted hardwood dowel pins inserted with glue. Dowel pins shall extend from the panel ends for joining into mating hole patterns in the cabinets' side panels.
- D. Wall Cabinets: Full 1-inch-thick panels of balanced construction, with the same fluted hardwood fluted dowel pin and glue joint construction as the base and tall cabinets.
- E. Kick Panels: 4-inch-high, set back from cabinets' front edge and mechanically fastened to cabinet bottom and ends, to be an integral part of cabinet structure.
- F. Back Panels: 3/8-inch-thick, set in 3/8 inch from rear panels of balanced construction surfaced as described.
- G. Finished exposed backs of fixed cabinets shall be 3/4-inch-thick panels of balanced construction surfaced as described.
- H. Hanging rails to be provided in wall cabinets in upper back corner for mounting units to walls.
- I. Cabinet Subbase:
 - 1. To be separate and continuous (no cabinet body sides-to-floor), water-resistant exterior grade plywood with concealed fastening to cabinet bottom.
 - 2. Ladder-type construction of front, back and intermediates to form a secure and level platform to which cabinets attach.

2.7 FABRICATION, MOBILE CASEWORK

- A. Corner Joints: Incorporate a rigid fluted hardwood dowel pin construction system, glued and clamped under pressure.
- B. Ends: 3/4-inch-thick panels of balanced construction precision bored for dowel pins installed in horizontal cabinet members.
- C. Mobile Cabinets: Provide with a double bottom and top frame panel design.
 - 1. Interior bottoms and tops, 3/4-inch-thick panels of balanced construction. The front leading edge of these panels built-up to 1-1/2 inch thick and edged with rigid PVC. Panels bored to receive fluted dowel pins with pins to be inserted with glue and join mating hole pattern in cabinet side panel.
 - 2. Exterior bottoms and tops, 3/4-inch thick panels of balanced construction. Panels to extend past all four sides of the unit and edged with high impact plastic extrusion to form a wrap-around bumper system to prevent damage during normal use. Bumper system shall be standard on all mobile units.
- D. Casters: Provide each mobile cabinet with four heavy duty 5-inch ball bearing swivel casters with a minimum wheel face of 1-1/4 inches, and 290-lb working load rating per caster. Provide two front casters with wheel lock. Attach each caster with four flat head bolts with lock nuts through bottom panels.
- E. Backs: 3/4-inch-thick panel of balanced construction and finished with exterior surfaces laminate. Backs tenoned into cabinet ends and grooved to accept interior top and bottom panels, and fastened with glue, screws, and corner brackets.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Do not install casework units until painting and drywall work in the space has been completed and the space is dry.
- B. Install cabinets in such a way that relocation can be accomplished without marred end panels and use of special tools.
- C. Install cabinets under supervision of manufacturer's representative with factory-trained journeymen authorized by manufacturer.
- D. Install cabinets indicated on Drawings in correct locations.
- E. Erect casework straight, level and plumb and securely anchor in place; base cabinets installed on plywood ladder bases.
- F. Mount wall-hung cabinets on concealed 1-by-3 softwood hanging strips secured to wall with expansion or toggle bolts, minimum four per cabinet.
- G. Firmly anchor fixed cabinets and any required scribe moldings to walls and floors. Finish of scribe molding shall match cabinets.
- H. Furnish scribes 3/4 inch thick and filler pieces to fill spaces in material matching cabinet panels or frames, between units and between units and walls where open spaces occur.
- I. Patch surfaces damaged by installation to new condition or remove and install new material as approved.
- J. Rims of sinks specified in Division 22 shall be set in sealant to insure waterproof seal between rim and countertop.
- K. Seal joints between all cabinets and wall.

3.3 CLEANING AND PROTECTION

- A. Leave finished work clean, free of scratches, dents, gouges, or other damage, with doors and drawers operating freely at time of final acceptance. Leave work area clean and free of debris.
- B. Protect materials and installed casework from damage by work of other trades.

END OF SECTION

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SECTION 12 36 00 - COUNTERTOPS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Countertops for architectural cabinet work.
- B. Countertops for manufactured casework.
- C. Wall-hung counters and vanity tops.
- D. Sinks molded into countertops.

1.2 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework.
- B. Section 12 35 50 - Institutional Casework.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard 2016.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- C. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.
- D. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- E. PS 1 - Structural Plywood 2009.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- F. Sustainable Design Submittal: Documentation for sustainably harvested wood-based components.
- G. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- H. Reports: Provide documentation of VOC content in g/L for adhesives applied within the building waterproofing envelope; document no added urea formaldehyde for composite wood, agrifiber products and laminating adhesives.
- I. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.
- B. Installer Qualifications: Fabricator.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 COUNTERTOPS

- A. Solid Surfacing Countertops (Type SS): Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/4 inch, minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - b. Sinks and Bowls at Kitchen Sinks and Restroom Lavatories: Integral castings; minimum 3/4 inch wall thickness.
 - 1) Basis-of-Design for integrated sink: Corian 5610 - Accessible Collection.
 - 2) Basis-of-Design for integrated lavatory: Corian 810-Accessible Collection.
 - c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - d. Color and Pattern: To be selected from manufacturer's full line.
 - e. Manufacturers:
 - 1) Dupont : www.corian.com.
 - 2) Formica Corporation : www.formica.com.
 - 3) LG Hausys: www.lghimacsusa.com.
 - 3. Other Components Thickness: 1/2 inch, minimum.
 - 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
 - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
 - 6. Skirts: As indicated on drawings.

2.2 MATERIALS

- A. Wood-Based Components:
 - 1. Wood fabricated from old growth timber is not permitted.
 - 2. Composite Wood and Agrifiber Products: No added urea formaldehyde.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; joint lengths using metal splines.
- C. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 47 pcf minimum density; minimum 3/4 inch thick; joint lengths using metal splines.

- D. Backer Sheet: Provide substrate with laminate backer sheet.
- E. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined, containing no added urea formaldehyde resins.

2.3 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches, unless otherwise indicated.
- C. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.
 - 1. Wall Brackets: Provide aluminum or steel brackets surface mounted at masonry walls and recess mounted at gypsum board walls.
 - a. Basis-of-Design: "Rakks" Counter Brackets - L-shaped bracket fabricated from aluminum T sections; Model No. EH-1818 and EH-1824 as manufactured by Rangine Corporation.
 - 1) Load capacity per bracket: 450 pounds.
 - 2) Finish: Powder coated, color as selected by Architect.
 - 3) Provide with 5/8 inch opening rubber grommet installed in 7/8 inch hole.
 - b. Other approved manufacturer:
 - 1) A&M Hardware Inc.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Seal joint between back/end splashes and vertical surfaces.

3.4 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.

3.5 CLEANING AND PROTECTION

- A. Clean countertops surfaces thoroughly.
- B. Protect installed products until completion of project.
- C. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 11 24 23 - FALL PROTECTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: This Section specifies design, supply and installation of Fall Protection systems if such systems are not provided with the roof ladder.

1.2 REFERENCES

- A. American Institute of Steel Construction (AISC).
1. AISC S342L, Load and Resistance Factor Design Specification for Structural Steel Buildings (including Supplement No.1).
- B. Aluminum Association (AA).
1. AA DAF 45, Designation System for Aluminum Finishes.
 2. AA ADM-1, Aluminum Design Manual.
- C. American Society of Mechanical Engineers (AMSE).
1. ASME A120.1, Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance.
- D. American National Standards Institute / International Window Cleaning Association (ANSI/IWCA).
1. ANSI/IWCA I-14.1, Window Cleaning Safety Standard.
- E. American Welding Society (AWS).
1. AWS D1.2/D1.2M, Structural Welding Code - Aluminum.
 2. AWS D1.1/D1.1M, Structural Welding Code—Steel.
- F. ASTM International (ASTM).
1. ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 2. ASTM A167, Specification for Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip.
 3. ASTM A276, Standard Specification for Stainless Steel Bars and Shapes.
 4. ASTM A492 Standard Specification for Stainless Steel Rope.
 5. ASTM B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- G. International Code Council (ICC).
1. International Building Code.
- H. Occupational Safety and Health Administration (OSHA).
1. OSHA 1910, Subpart D, Walking and Work Surfaces.
 2. OSHA 1910, Subpart F, Appendix C, Personal Fall Arrest Systems.
 3. OSHA Ruling on Window Cleaning by Bosun's Chair.
 4. OSHA 1910.66 Subpart F, Powered Platforms.
- I. National Roofing Contractor's Association (NRCA)
1. The NRCA Roofing and Waterproofing Manual, Fifth Edition.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate information on shop drawings as follows:
1. Submit shop drawings showing complete layout and configuration of fall protection equipment including components and accessories.

2. Indicate design and fabrication details, hardware, and installation details.
 3. Include installation and rigging instructions and:
 - a. Required restrictive working usage and general safety notes.
 - b. Non-restrictive working usage and general safety notes.
 4. Ensure Shop Drawings are reviewed by Engineer licensed in State of Maryland and submit calculations and test reports to Architect.
- B. Submit product data, including manufacturer's technical data sheet, for specified products.
- C. Quality Assurance:
1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
 2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
 3. Manufacturer's installation instructions.
- D. Submit 1-year standard manufacturer warranty documents specified.
- E. Operation and Maintenance Data: Submit Operation and Maintenance data for installed products.
1. Include:
 - a. Manufacturer's instructions covering maintenance requirements and parts catalog giving complete list of repair and replacement parts with cuts and identifying numbers.

1.4 QUALITY ASSURANCE

- A. Qualifications:
1. Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.
 2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction and approving application method.
- B. Regulatory Requirements.
1. Comply with International Building Code (IBC)
 2. Comply with OSHA regulations as follows:
 - a. 1910, Subpart D, Walking and Working Surfaces.
 - b. Appendix C to 1910 Subpart F, Personal Fall Arrest Systems.
- C. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
1. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.
- B. Storage and Protection:
1. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.6 SEQUENCING

- A. Sequence with other Work and Comply with window washing equipment manufacturer's written recommendations for sequencing construction operations.

1.7 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under Contract Documents.
- B. Warranty: Commencing on date of substantial completion set by Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturer: Pro-Bel Group of Companies, Phone: (905) 427-0616, USA Toll Free: (800) 461-0575, Fax: (905) 427-2545, E-mail: <mailto:info@pro-belgroup.com>, www.pro-belgroup.com

2.2 DESIGN PERFORMANCE REQUIREMENTS

- A. Design system fall arrest safety anchors and equipment supports to AISC S342L (including supplement No.1) and ANSI/IWCA I-14.1, and as follows:
 - 1. Comply with OSHA 1910, Subpart F, Appendix C.
 - 2. Fall Arrest Safety Anchors:
 - a. Fall arresting force safety factor of 2 to 1 without permanent deformation: 1800 lbs (8.0 kN) minimum.
 - b. Fall arrest force against fracture or detachment: 5,000 lbs (22.4 kN) minimum.

2.3 ANCHORS

- A. Safety U-bars: Stainless steel to ASTM A276, Type 304 with 35 Ksi (240 MPa) minimum yield strength.
 - 1. U-bar: 0.75 inches (19 mm) minimum diameter material with 1.5 inches (38 mm) eye opening.
- B. Hollow Steel Section (HSS) Piers: Mild steel, Type 300W with 50 Ksi (350 MPa) minimum yield strength, hot dipped galvanized to ASTM A123/A123M
 - 1. Wall thickness to suit application.
- C. Plate and other sections: Mild steel, Type 300W with 44 Ksi (300 MPa) minimum yield strength, hot dipped galvanized to ASTM A123/A123M
 - 1. Wall thickness to suit application.
- D. Seamless Spun Aluminum Flashing (for Roof Anchors): To AA ADM-1 Type 6061-T6 alloy and to ASTM B221.
 - 1. Deck flange flashing: To NRCA Roofing and Waterproofing Manual recommendations.
 - 2. Manufacturers standard Aluminum Deck Flange Flashing.
- E. Miscellaneous Bolts, Nuts and Washers: Stainless steel to ASTM A276, Type 304 with 35 Ksi (240 MPa) minimum yield strength.

2.4 SOURCE QUALITY CONTROL

- A. Ensure Fall Protection equipment components and materials are from single manufacturer.

PART 3 EXECUTION

3.1 INSTALLERS

- A. Provide experienced and qualified technicians to carry out erection, assembly and installation of fall protection and suspended maintenance equipment system.
- B. Do steel welding to AWS D1.2/D1.2M.
- C. Do aluminum welding to AWS D1.1/D1.1M.

3.2 MANUFACTURERS INSTRUCTIONS

- A. Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions and manufactures technical data sheets.

3.3 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Verify that substrate conditions are acceptable for product installation in accordance with manufacturer's instructions prior to installation.
 - 2. Inform Architect of unacceptable conditions immediately upon discovery.
 - 3. Proceed with installation only after unacceptable conditions have been remedied.

3.4 PREPARATION

- A. Ensure structural steel to receive safety anchors has adequate bearing surface as indicated on shop drawings.

3.5 INSTALLATION

- A. Coordinate fall protection work with work of other trades, for proper time and sequence to avoid construction delays.
- B. Install fall protection equipment plumb and level in accordance with manufacturer's written instructions.
- C. Mechanically fasten anchors in accordance with manufacturer's recommendations.
- D. Accurately fit and align, securely fasten and install free from distortion or defects.
- E. Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal and vandalism.

3.6 FIELD QUALITY CONTROL

- A. When necessary have the manufacture assist in installation.

3.7 FINAL CLEANING

- A. Upon completion, remove surplus and excess materials, rubbish, tools and equipment.

3.8 PROTECTION

- A. Protect installed product from damage during construction.
- B. Make good damage to adjacent materials caused by fall protection equipment installation.

END OF SECTION

SECTION 11 30 13 - APPLIANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Appliances.

1.2 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory Current Edition.

1.3 QUALITY ASSURANCE

A. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

PART 2 PRODUCTS

2.1 APPLIANCES

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify utility rough-ins are provided and correctly located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Anchor built-in equipment in place.

3.3 ADJUSTING

A. Adjust equipment to provide efficient operation.

3.4 CLEANING

A. Remove packing materials from equipment and properly discard.

B. Wash and clean equipment.

END OF SECTION

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SECTION 12 35 50 - INSTITUTIONAL CASEWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes plastic laminate casework and related items including, but not limited to, countertops, back splashes, filler panels, and scribe pieces, as necessary for complete installation.
 - 1. Related Sections include the following:
 - a. Division 8 Section "Resilient Flooring" for resilient wall base.
 - b. Division 25 Sections for sinks and fittings in countertops.
 - c. Division 26 Sections for electrical fittings and outlets.

1.2 SUBMITTALS

- A. Product Data: For each type of educational casework unit specified.
- B. Shop Drawings: Include plan layout, elevations, ends, cross-sections, location and type of service fittings, required clearances, methods of assembly and reassembly, design and arrangements.
- C. Samples for Selection: Manufacturer's color charts and material samples showing full range of colors, textures, and finishes. Submit a basic container unit with shelves, dividers, base and hardware. Samples must have cutaways to clearly demonstrate materials, construction, workmanship, and finish.
- D. Sample for Verification: Submit full size sample of typical cabinet which may be incorporated into the Work if in good condition and approved by Architect. Owner may take one cabinet unit off site for deconstructive testing. Cabinet will be selected at random. Replace unit at no extra cost to Owner.
- E. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.
- F. Maintenance Data: For educational casework to include in maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

- A. Forest Certification: Provide wood products made from forests certified by an FSC-accredited certification body. All non-FSC wood in assemblies with FSC-certified wood shall meet the FSC Controlled Wood (CW) criteria.
- B. Installer Qualifications: Engage a firm specializing in installation of casework for a minimum of 5 years and acceptable to manufacturer.
- C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Unless modified by notation on Drawings, or otherwise specified, catalog description for designated product constitutes requirements for each product and establishes a standard of design and quality for materials, construction and workmanship. Other acceptable manufacturers' laboratory casework of similar sizes, similar door and drawer configurations, and complying with the Specifications will be accepted

- D. Single Source Responsibility: To assure coordinated unit design, all items in each room or space, other than appliances and special equipment specified in other Sections, shall be products of one manufacturer to the greatest extent possible.
- E. Quality Standard: Except as otherwise indicated, comply with the following standards:
 - 1. AWI Cabinet Quality Standard: AWI Section 1600.
 - 2. AWI Countertop Quality Standard: AWI Section 400C.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Administrative Requirements."

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating educational casework without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of educational casework that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: 3 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Basis-of-Design: Stevens.
 - 2. Case Systems, Inc.
 - 3. The Mastercraft Woodworking Company.
 - 4. TMI Systems Design Corporation.
 - 5. Paragon Casework.

2.2 MATERIALS

- A. Composite wood installed within the building interior: Comply with California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM), Phase II for ultra-low-emitting formaldehyde (ULEF) resins or containing no added formaldehyde resins.
- B. High Pressure Decorative Laminate: NEMA LD3, grades as indicated.
 - 1. Plastic Laminate: Vertical General Purpose Grade (VGS), 0.030-inch nominal thickness; for exterior cabinet surfaces, interiors of open cabinets, and underside of wall cabinets.
 - 2. Plastic Laminate Balancing Sheet: Cabinet Liner Grade (CLS), 0.020-inch nominal thickness, white high-pressure cabinet liner, for balancing exterior laminate surfaces.
- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Formica Corporation.
- b. Nevamar; International Paper; Decorative Products Div.
- c. Wilsonart International; Div. of Premark International, Inc.
2. Color: Basis-of-Design - Beigewood 7850-60 (Matte) from Wilsonart.
3. End panels may match face or may be a color as selected from manufacturer's standard finishes and colors.
4. A maximum total of 12 different casework colors will be selected for this Project. All exposed exterior elements including edges, door and cabinet sides, and exposed backs shall be available in matching color.
- D. Pressure Fused Laminate: Melamine resin impregnated, 90 gram PSM minimum, thermofused to core under pressure, complying with NEMA LD3 VGS and NEMA LD3 CLS standards.
 1. Provide white pressure fused laminate for cabinet interiors behind doors and drawers.
 2. Provide balanced construction at all concealed surfaces with thermofused melamine. Unsurfaced coreboard or simple backers will not be accepted.
- E. Plywood complying with DOC PS 1.
- F. Hardboard:
 1. Hardboard shall meet or exceed Commercial Standards CS-251 and Federal Specifications LLL-B-00810.
 2. Tempered Hardboard 1/4 inch thick, smooth both sides.
 3. Hardboard exposed one side to be 1/4 inch thick, prefinished in putty color to match cabinet interior. Opposite face prefinished with neutral color balance coating.
- G. Edging Materials: Comply with the following:
 1. Exposed Exterior Cabinet Edges, Interior Dividers, Drawer Bodies, and Shelves: Banded with matching material, resistant to chipping, cracking, and high impact, applied with waterproof hot melt adhesive.
 2. Door and Drawer Front Edges: Banded with contrasting or matching PVC extrusion, 3 mm thick, resistant to chipping, cracking, and high impact, applied with waterproof hot melt adhesive, and shaped to provide radiused edges and corners.
 3. Color selection for PVC edging will be made at a later date; Architect reserves the right to select colors manufactured and offered by Woodtape Edge Banding (at no additional cost to the Owner), when a standard selection offered by the casework manufacturer does not provide a suitable color in the Architect's opinion.
- H. Hardware:
 1. Hinges: Hinges fully concealed from view when door is in closed position and shall permit 176-degree door swing. Hinge crank of heavy duty steel with a concealed integral self-closing spring mechanism. Hinge bosses of heavy duty diecast steel. Nylon expansion inserts to be provided in door for positive screw attachment. Hinge shall incorporate mounting features providing three-dimensional adjustment. Hinges to have lifetime guarantee as warranted by manufacturer. Doors less than 48 inches in height with 2 hinges per door, doors 48 to 63 inches in height with 3 hinges per door and all doors in excess of 63 inches with 4 hinges per door.
 2. Wire Pulls: Stainless steel, accurately positioned on door and drawer front with #8-32 screws.
 3. Door Catch: Heavy duty, spring-loaded, large roller type. Each door with a single catch mounted at the bottom edge. All mobile cabinets and doors over 48 inches high with a catch at both top and bottom of door.

4. Catch Strike Plate: Injection molded nylon, almond color, with integral molded engagement ridge. Strike plate to also provide a wide face bumper insuring a positive door stop.
 5. Hanger Rods: 1-inch diameter heavy gage plated tubing, securely affixed in cabinet with injection molded rod sockets.
 6. Drawer and Slide-Out Shelf Slides: Nylon roller steel slides to insure quiet, smooth operation. 100-lb load rating with built-in drawer stop and self-close feature in the last 1-inch of travel.
 7. File Drawer Slides: Full extension steel slides with ball bearing nylon rollers. 100-lb. load rating.
 8. Locks: Cylinder type, diecast, with 5 disc tumbler mechanism. Each lock to be provided with a milled brass key with keying options of keyed alike, keyed different, and master keyed locks, as selected by Owner. Provide locks on all cabinet doors and drawers, except sink and fumehood base cabinets.
 9. Grommets: Plastic or metal, 1.5-inch-diameter, placed at each computer station.
- I. Adjustable Shelf Support System:
1. Support Clips for Adjustable Shelves: 3/4-inch-and 1-inch-thick, injection molded nylon, incorporating integrally molded lock tabs to retain shelf from tipping or inadvertently being lifted out. Support clip to have double pin engagement into precision bored hole pattern in cabinet vertical members, with molded ridge in the clip body to provide additional pressure against edge of shelving and to maintain positive pin engagement. Clip shall be designed to provide means to permanently attach shelf to support clips. Static test load must exceed 200-lb per clip.
 2. Vertical and Horizontal Shelf Dividers: 1/4-inch-thick, fully adjustable and retained with injection molded nylon support clip designed to trap divider to eliminate inadvertent lift out.
 3. Adjustable Shelves and Dividers: Adjustable at 1.25 inches o.c. through full height of compartment.
- J. Wardrobe Clothes Pole: 1-1/16-inch chrome steel rod – LH-362.
- K. Wardrobe Clothes Pole Socket: Knap & Vogt #734 Flange Chrome.
- L. Coat Hooks:
1. Single coat hooks - HEWI No. 520.60.1 ABS plastic, color to be selected by Architect from manufacturer's full range.
 2. Double coat hooks - HEWI 520.50.2 ABS plastic, color to be selected by Architect from manufacturer's full range.
 3. Ceiling hooks - HEWI 513 ABS plastic, color to be selected by Architect from manufacturer's full range.
- M. Hangers: Captive and removable wood or metal; 17-inch.
- N. Recycled Content: Provide particleboard and MDF with minimum 80 percent recycled content.
- 2.3 COUNTERTOPS
- A. Reference Section 12 36 00 Countertops.
- 2.4 FABRICATION, GENERAL
- A. Cabinet Construction: High-pressure plastic laminate surface finish; flush overlay type door/drawer style.
- B. Chemical Content: All materials used shall be relatively nontoxic when exposed to heat or flame.

- C. Wall Hung Units: When mounted on a wall and loaded with 25 psf on all horizontal surfaces, units shall resist a lateral force applied at the bottom of the cabinet parallel to the long dimension of the cabinet of 300 lbs without failure. Each wall hung unit shall safely support a uniform load of 600 lbs.
- D. Storage units with or without doors shall be able to have shelves and/or vertical dividers rearranged within one or more units of same size without defacing interior of unit.

2.5 FABRICATION, CABINETS

A. Drawers:

1. Drawers: Full box body design with a separate front; body sides and ends minimum 5/8-inch medium density fiberboard with almond color melamine laminate faces and matching almond color PVC top edges; bottoms minimum 1/4-inch thick medium density fiberboard with almond color facing.
2. Corner Joints: Interlocking dowel pin design, with 8mm diameter dowel pins inserted into drawer ends and fitted into matching hole patterns in drawer sides. Bottoms to be let into grooves all four sides; all joints glued and bottoms shall have additional mechanical fasteners; drawers to operate on mechanical slides as separately described.
3. Separate drawer front, surfaced and edges as described, attached to drawer body with no less than 4 screws through front side.

B. Solid Hinged Doors: 3/4-inch thick plywood core, balanced construction laminate faces. Surfacing, edging and hinges as separately described.

C. Solid Sliding Doors: 3/4-inch thick plywood core, balanced construction laminate faces. Each door with 2 nylon rollers mounted in bottom of door panel, and with door operating in aluminum top and bottom tracks. Surfacing and edging as separately described.

D. Sliding Display Doors: Constructed of 1/4-inch thick, distortion free glazing sheets. Outer edge to have full length aluminum pull channel for strength. Doors must be accurately sized for easy movement in upper and lower extruded aluminum guide channels.

E. Adjustable Shelves: Shelves less than 36 inches in length shall be 3/4 inches thick. Shelves 36 inches long and over, and all adjustable shelves in wall cabinets and bookcases shall be 1 inch thick. Shelves shall be constructed of plywood with almond color melamine laminate surfaces. Leading edge of shelf finished with a high impact, rigid PVC extrusion, almond in color to match shelf surface and cabinet interior. Exposed surfaces of open shelving without doors shall be finished with plastic laminate.

F. Frame Rails Between Drawers: Full cabinet length, 3/4 inches thick by 3-1/2 inches wide, pinned, and fastened into cabinet sides. Front leading edge to be edged as separately described.

G. Tote Trays: High impact polystyrene with smooth edges. Provide each tray with a card holder. Suspend tote trays from rails securely attached to cabinet partitions and sides.

2.6 FABRICATION, FIXED CASEWORK (BASE, WALL, HUTCH, AND TALL UNITS)

A. Corner Joints: Incorporate fluted hardwood dowel pin construction, factory glued and clamped under pressure to assure rigid loadbearing corner joints.

B. Cabinet Ends: 3/4-inch-thick panels of balanced construction, precision bored for fluted hardwood dowel pins installed in horizontal cabinet members. Base and tall units with one piece end panels continuous to floor for added load capability. Unexposed ends with laminate backing sheet.

- C. Cabinet Bottoms and Tops: 3/4-inch-thick panels of balanced construction for base and tall units. Precision bore panels to receive fluted hardwood dowel pins inserted with glue. Dowel pins shall extend from the panel ends for joining into mating hole patterns in the cabinets' side panels.
- D. Wall Cabinets: Full 1-inch-thick panels of balanced construction, with the same fluted hardwood fluted dowel pin and glue joint construction as the base and tall cabinets.
- E. Kick Panels: 4-inch-high, set back from cabinets' front edge and mechanically fastened to cabinet bottom and ends, to be an integral part of cabinet structure.
- F. Back Panels: 3/8-inch-thick, set in 3/8 inch from rear panels of balanced construction surfaced as described.
- G. Finished exposed backs of fixed cabinets shall be 3/4-inch-thick panels of balanced construction surfaced as described.
- H. Hanging rails to be provided in wall cabinets in upper back corner for mounting units to walls.
- I. Cabinet Subbase:
 - 1. To be separate and continuous (no cabinet body sides-to-floor), water-resistant exterior grade plywood with concealed fastening to cabinet bottom.
 - 2. Ladder-type construction of front, back and intermediates to form a secure and level platform to which cabinets attach.

2.7 FABRICATION, MOBILE CASEWORK

- A. Corner Joints: Incorporate a rigid fluted hardwood dowel pin construction system, glued and clamped under pressure.
- B. Ends: 3/4-inch-thick panels of balanced construction precision bored for dowel pins installed in horizontal cabinet members.
- C. Mobile Cabinets: Provide with a double bottom and top frame panel design.
 - 1. Interior bottoms and tops, 3/4-inch-thick panels of balanced construction. The front leading edge of these panels built-up to 1-1/2 inch thick and edged with rigid PVC. Panels bored to receive fluted dowel pins with pins to be inserted with glue and join mating hole pattern in cabinet side panel.
 - 2. Exterior bottoms and tops, 3/4-inch thick panels of balanced construction. Panels to extend past all four sides of the unit and edged with high impact plastic extrusion to form a wrap-around bumper system to prevent damage during normal use. Bumper system shall be standard on all mobile units.
- D. Casters: Provide each mobile cabinet with four heavy duty 5-inch ball bearing swivel casters with a minimum wheel face of 1-1/4 inches, and 290-lb working load rating per caster. Provide two front casters with wheel lock. Attach each caster with four flat head bolts with lock nuts through bottom panels.
- E. Backs: 3/4-inch-thick panel of balanced construction and finished with exterior surfaces laminate. Backs tenoned into cabinet ends and grooved to accept interior top and bottom panels, and fastened with glue, screws, and corner brackets.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Do not install casework units until painting and drywall work in the space has been completed and the space is dry.
- B. Install cabinets in such a way that relocation can be accomplished without marred end panels and use of special tools.
- C. Install cabinets under supervision of manufacturer's representative with factory-trained journeymen authorized by manufacturer.
- D. Install cabinets indicated on Drawings in correct locations.
- E. Erect casework straight, level and plumb and securely anchor in place; base cabinets installed on plywood ladder bases.
- F. Mount wall-hung cabinets on concealed 1-by-3 softwood hanging strips secured to wall with expansion or toggle bolts, minimum four per cabinet.
- G. Firmly anchor fixed cabinets and any required scribe moldings to walls and floors. Finish of scribe molding shall match cabinets.
- H. Furnish scribes 3/4 inch thick and filler pieces to fill spaces in material matching cabinet panels or frames, between units and between units and walls where open spaces occur.
- I. Patch surfaces damaged by installation to new condition or remove and install new material as approved.
- J. Rims of sinks specified in Division 22 shall be set in sealant to insure waterproof seal between rim and countertop.
- K. Seal joints between all cabinets and wall.

3.3 CLEANING AND PROTECTION

- A. Leave finished work clean, free of scratches, dents, gouges, or other damage, with doors and drawers operating freely at time of final acceptance. Leave work area clean and free of debris.
- B. Protect materials and installed casework from damage by work of other trades.

END OF SECTION

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SECTION 12 36 00 - COUNTERTOPS**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Countertops for architectural cabinet work.
- B. Countertops for manufactured casework.
- C. Wall-hung counters and vanity tops.
- D. Sinks molded into countertops.

1.2 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework.
- B. Section 12 35 50 - Institutional Casework.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard 2016.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- C. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.
- D. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- E. PS 1 - Structural Plywood 2009.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- F. Sustainable Design Submittal: Documentation for sustainably harvested wood-based components.
- G. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- H. Reports: Provide documentation of VOC content in g/L for adhesives applied within the building waterproofing envelope; document no added urea formaldehyde for composite wood, agrifiber products and laminating adhesives.
- I. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.
- B. Installer Qualifications: Fabricator.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 COUNTERTOPS

- A. Solid Surfacing Countertops (Type SS): Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/4 inch, minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - b. Sinks and Bowls at Kitchen Sinks and Restroom Lavatories: Integral castings; minimum 3/4 inch wall thickness.
 - 1) Basis-of-Design for integrated sink: Corian 5610 - Accessible Collection.
 - 2) Basis-of-Design for integrated lavatory: Corian 810-Accessible Collection.
 - c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - d. Color and Pattern: To be selected from manufacturer's full line.
 - e. Manufacturers:
 - 1) Dupont : www.corian.com.
 - 2) Formica Corporation : www.formica.com.
 - 3) LG Hausys: www.lghimacsusa.com.
 - 3. Other Components Thickness: 1/2 inch, minimum.
 - 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
 - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
 - 6. Skirts: As indicated on drawings.

2.2 MATERIALS

- A. Wood-Based Components:
 - 1. Wood fabricated from old growth timber is not permitted.
 - 2. Composite Wood and Agrifiber Products: No added urea formaldehyde.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; joint lengths using metal splines.
- C. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 47 pcf minimum density; minimum 3/4 inch thick; joint lengths using metal splines.

- D. Backer Sheet: Provide substrate with laminate backer sheet.
- E. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined, containing no added urea formaldehyde resins.

2.3 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches, unless otherwise indicated.
- C. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.
 - 1. Wall Brackets: Provide aluminum or steel brackets surface mounted at masonry walls and recess mounted at gypsum board walls.
 - a. Basis-of-Design: "Rakks" Counter Brackets - L-shaped bracket fabricated from aluminum T sections; Model No. EH-1818 and EH-1824 as manufactured by Rangine Corporation.
 - 1) Load capacity per bracket: 450 pounds.
 - 2) Finish: Powder coated, color as selected by Architect.
 - 3) Provide with 5/8 inch opening rubber grommet installed in 7/8 inch hole.
 - b. Other approved manufacturer:
 - 1) A&M Hardware Inc.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Seal joint between back/end splashes and vertical surfaces.

3.4 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.

3.5 CLEANING AND PROTECTION

- A. Clean countertops surfaces thoroughly.
- B. Protect installed products until completion of project.
- C. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 12 93 00 - SITE FURNISHINGS**PART 1 - GENERAL:****1.1 SUMMARY**

- A. This Section includes the following site and street furnishings:
 - 1. Bike Racks
- B. Related Sections include the following:
 - 1. Division 31 Section "Earthwork" for excavation for installation of concrete footings.
 - 2. Division 3 Section "Cast-in-Place Concrete" for formed voids in concrete footings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, field-assembly requirements, and installation details.
 - 1. Submit location of product manufacture
- B. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Size: Not less than 6-inch- long linear components and 4-inch- square sheet components.
- C. Product Schedule: For site furnishings. Use same designations indicated on Drawings.
- D. Material Certificates: For site furnishings, signed by manufacturers.
 - 1. Recycled plastic.
- E. Maintenance Data: For site furnishings to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of site and street furnishings through one source from a single manufacturer.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Bench Replacement Slats: Not less than two full-size units for each size indicated.
 - 2. Trash Receptacle Inner Containers: 1 full-size unit.

PART 2 - PRODUCTS:**2.1 MANUFACTURERS**

- A. Basis-of-Design Products: Subject to compliance with requirements, provide the following products by or a comparable product by another manufacturer approved by Architect prior to bid, giving preference to products manufactured within a 500-mile radius of the Project Site.
 - 1. Bike Racks: Columbia Cascade Company; Model 2170-11-P-C

2.2 MATERIALS

- A. Steel: Free from surface blemishes and complying with the following:
 - 1. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53, or electric-resistance-welded pipe complying with ASTM A 135.
 3. Tubing: Cold-formed steel tubing complying with ASTM A 500.
 4. Sheet: Commercial steel sheet complying with ASTM A 569/A 569M.
 - B. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.
 1. Recycled Polyethylene: Fabricated from not less than 96 percent recycled, purified, fractional-melt plastic resin for not less than 90 percent recycled post-consumer waste by weight content HDPE.
 - C. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality; tamperproof, vandal and theft resistant; concealed, recessed, and capped or plugged. Provide as required for site furnishings' assembly, mounting, and secure attachment.
 - D. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- 2.3 BIKE RACKS:
- A. Frame: Steel.
 - B. Table Height: As indicated by basis-of-design product.
 - C. Overall Width: 10 feet.
 - D. Overall Depth: As indicated by basis-of-design product.
 - E. Weight: As indicated by basis-of-design product.
 - F. HDPE Color: As selected by Architect from manufacturer's full range.
- 2.4 FABRICATION
- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
 - B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
 - C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
 - D. Steel and Iron Components: Galvanized, galvanized and color coated, or color coated. Bare metal steel or iron components are not permitted.
 - E. Exposed Surfaces: Polished, sanded, or otherwise finished; smooth all surfaces, free from burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
 - F. Factory Assembly: Assemble components in the factory to the greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.
- 2.5 FINISHES, GENERAL
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations

in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 STEEL AND GALVANIZED STEEL FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester-TGIC, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION:

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions, unless more stringent requirements are indicated. Complete field assembly of site and street furnishings, where required.
- B. Unless otherwise indicated, install site and street furnishings after landscaping and paving have been completed.
- C. Install site and street furnishings level, plumb, true, and securely anchored or positioned at locations indicated on Drawings.

3.3 CLEANING

- A. After completing site and street furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION

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SECTION 220000 - PLUMBING BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Work included in 22 00 00, Plumbing Basic Requirements applies to Division 22, Plumbing work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of plumbing systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

- A. Contents of Section applies to Division 22, Plumbing Contract Documents.
- B. Related Work:
 - 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, individual Division 22, Plumbing Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:

1. State of Virginia:
 - a. 2015 Virginia Construction Code
 - 1) Adopts the 2015 International Building Code (IBC) with amendments
 - 2) Adopts the 2014 National Electrical Code (NEC) with amendments
 - b. 2015 Virginia Residential Code
 - 1) Adopts the 2015 International Residential Code (IRC) with amendments
 - c. 2015 Virginia Fuel Gas Code
 - 1) Adopts the 2015 International Fuel Gas Code (IFGC) with amendments
 - d. 2015 Virginia Mechanical Code
 - 1) Adopts the 2015 International Mechanical Code (IMC) with amendments
 - e. 2015 Virginia Plumbing Code
 - 1) Adopts the 2015 International Plumbing Code (IPC) with amendments
 - f. 2015 Virginia Statewide Fire Code
 - 1) Adopts the 2015 International Fire Code (IFC) with amendments
 - g. 2015 Virginia Energy Conservation Code
 - 1) Adopts the 2015 International Energy Conservation Code (IECC) with amendments
 - h. 2015 Virginia Existing Building Code
 - 1) Adopts the 2015 International Existing Building Code (IEBC) with amendments

C. See Division 22, Plumbing individual Sections for additional references.

1.4 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 22, Plumbing Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. At Contractor's option, two separate submittals may be provided, consisting of underground work and building work. Deviations will be returned without review.
 3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 22, Plumbing Sections.

4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
 - a. Label submittal to match numbering/references as shown in Contract Documents and schedules. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference Division 22, Plumbing Sections for specific items required in product data submittal outside of these requirements.
 - c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
 - d. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.
 - e. See Division 22, Plumbing Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-16 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 22, Plumbing Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
10. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of

that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

11. Shop Drawings: Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout plans, and control wiring diagrams. Reference individual Division 22, Plumbing Sections for additional requirements for Shop Drawings outside of these requirements.
 - a. Provide Shop Drawings indicating sanitary and storm cleanout locations and type to Architect for approval prior to installation.
 - b. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:
 - a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 - 1) Resubmit for review until review indicates no exception taken or "make corrections as noted".
 - 2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
14. Operation and Maintenance Manuals, Owner's Instructions:
 - a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
 - 3) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 4) Include copy of startup and test reports specific to each piece of equipment.

- 5) Include copy of final water systems balancing log along with pump operating data.
 - 6) Include commissioning reports.
 - 7) Include copy of pressure, flow, leakage and purity test data and water systems test data, as applicable.
 - 8) Include copy of valve charts/schedules.
 - 9) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
 - 10) Include product certificates of warranties and guarantees.
 - 11) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
- b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 22 00 00, Plumbing Basic Requirements article titled "Demonstration".
 - c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
15. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
 - c. At completion of project, input changes to original project on Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit Revit Model and drawings upon substantial completion.
 - d. Provide Invert elevations and dimensioned locations for water services, building waste, and storm drainage piping below grade extending to 5-feet outside building line.
 - e. See Division 22, Plumbing individual Sections for additional items to include in record drawings.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturers equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.
- H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.6 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty in Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

- A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings) to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements,

Division 23, HVAC to combine information furnished by other trades onto master coordination documents.

- B. Prepare Drawings as follows:
 - 1. Drawings in Revit Model. Revit Model release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
 - 2. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
 - 3. Indicate plumbing system piping including fittings, hangers, access panels, valves, and bottom of pipe elevations above finished floor.
 - 4. Indicate inverts and provision for piping that must be graded to have right-of-way over more flexible items. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC equipment, ductwork and piping.
 - 5. Incorporate Addenda items and change orders.
 - 6. Distribute drawings to trades and provide additional coordination as requested by other trades.
- C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- D. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.8 WORK INCLUDED

- A. Furnish and install sleeves, inserts and anchorage required for the installation, which are embedded in work of other trades. Sleeve, wrap and seal piping in concrete.
- B. Electrical: For plumbing trim/devices/equipment, provide, from the line voltage connection by Division 26, the low voltage electrical connections and wiring as required for complete and operable system. Includes, but is not limited to: Low voltage electrical raceway, wiring and accessories, such as step-down transformers as necessary for function of sensors and automatic valve and faucet controls. Supply step-down transformers and size wiring as recommended by manufacturer of plumbing trim/faucets requiring electrical low voltage connection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to fixtures, pumps, drains and equipment.

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data

and are to be UL or ETL listed and labeled or be approved by State, County, and City authorities prior to procurement and installation.

- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of Virginia, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Install equipment requiring access (i.e., drain pans, drains, control operators, valves, motors, cleanouts and water heaters) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:
 - 1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with the provisions of related earthwork Sections/divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
 - 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and

equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Pipe Installation:

1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
2. Include provisions for servicing and removal of equipment without dismantling piping.

G. Plenums:

1. Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.2 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 1. Underground piping installation prior to backfilling.
 2. Prior to covering walls.
 3. Prior to ceiling cover/installation.
 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.
- D. Final Punch:
 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Plumbing Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the plumbing systems are ready for final punch.
 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.3 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:

1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping, and wiring to point of connection.
3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. Organize work to minimize duration of power interruption.

3.4 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
 4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing piping and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
 5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.5 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.6 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before

installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.

2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
3. Protect bright finished shafts, bearing housings and similar items until in service.

3.7 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.8 CLEANING

- A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.9 INSTALLATION

- A. Confirm installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
 1. Do not place equipment in sustained operation prior to initial balancing of plumbing systems.
 2. Provide pump impellers to obtain Basis of Design design capacities.
- D. Provide miscellaneous supports/metals required for installation of equipment and piping.

3.10 PAINTING

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. Ferrous Metal: After completion of plumbing work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
 - 6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.11 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing and Balancing Reports
 - b. Cleaning
 - c. Operation and Maintenance Manuals
 - d. Training of Operating Personnel
 - e. Record Drawings
 - f. Warranty and Guaranty Certificates
 - g. Start-up/Test Document and Commissioning Reports

3.12 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Tests:
 - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
 - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.13 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that plumbing items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.14 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize plumbing equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

END OF SECTION

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General Motor Construction and Requirements
 - 2. Starters
 - 3. Variable Frequency Drives
 - 4. Disconnects

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NEMA Premium Efficiency.
 - 2. Energy Policy Act (EPACT), latest applicable version(s) for minimum motor efficiencies.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.
- B. In addition, meet the following:
 - 1. Field Installed Motors: Installed motors to be of single type, from one source and from a single manufacturer.
 - 2. Electrical components and materials to be UL and ETL listed/labeled as suitable for location and use.
 - 3. Variable Frequency Drives: Materials and installation for a complete adjustable frequency motor drive consisting of a pulse width modulated (PWM) inverter for use on a standard NEMA Design B induction motor. Design drive specifically for variable torque applications. Variable Frequency Drive (VFD) provided by Controls Section or equipment manufacturer.
 - a. A firm engaged in the production of this type of equipment for a minimum of 10 years.
 - b. Testing: Test printed circuit boards and burned in before being assembled into the completed VFD. Subject VFD to a preliminary functional test, minimum 8-hour burn-in, and computerized final test at 104 degrees F at full rated load.
 - c. Qualifications:
 - 1) UL Listed.
 - 2) C-UL listed or CSA approved.

- 3) Warranty: 12 months from the date of certified start-up. Include parts, labor, travel time, and expenses.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 1. For motors 50 HP and Larger: Provide five year manufacturer's limited warranty from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. General Motor Construction and Requirements:
 1. Lincoln Motors
 2. Century Electric Motors (formerly A.O. Smith Electrical Products)
 3. Baldor Electric (Reliance Electric)
 4. General Electric
 5. Toshiba
 6. Exceptions: Motors integral to equipment efficiency listing (EER, COP, etc.) per listing agency.
 7. Or approved equivalent.
- B. Starters:
 1. Cerus
 2. Eaton Electrical
 3. General Electric
 4. Siemens
 5. Schneider Electric/Square D
 6. Or approved equivalent.
- C. Variable Frequency Drives:
 1. ABB
 2. Allen Bradley
 3. Cerus
 4. Danfoss
 5. Emerson
 6. General Electric
 7. Siemens
 8. Schneider Electric/Square D
 9. Toshiba
 10. Trane
 11. Yaskawa
 12. Or approved equivalent.
- D. Disconnects:
 1. Provided and installed by Division 26, Section 262816, Enclosed Switches and Circuit Breakers. See this section for manufacturer information.

2.2 GENERAL MOTOR CONSTRUCTION AND REQUIREMENTS

- A. Electrical components and materials to be UL to ETL listed/labeled as suitable for location and use.
- B. Wiring installed in conduit.
- C. Electrical Service: Power wiring from source to motor termination under Division 26, Electrical. Coordinate location of disconnect and starter or motor controller. Combination starter/disconnects may be used in lieu of separate items.
- D. Electrical Service - Unless otherwise noted in the Contract Documents, the following voltage and phase characteristics apply to motors:
 - 1. Motors 1/2 HP and Under: 120 volt, 1 phase.
 - 2. Motors 3/4 HP and Over: 208 volt, 3 phase.
 - 3. Motors 3/4 HP and Over: 480 volt, 3 phase
- E. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 104 Degrees F environment.
 - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 4. Built-in thermal overload protection or externally protected with separate over-load with low-voltage release or lock-out. Quick trip device on hermetically sealed motors.
 - 5. Service Factor: 1.15 for poly-phase motors. 1.25 for motors associated with shaft pressurization system fans. 1.35 for single phase motors.
 - 6. Noise Rating: Quiet.
 - 7. Efficiency: Provide premium efficiency motors.
 - 8. Motors used in Conjunction with Variable Speed Drives: Variable torque type matched for the full operating range of the variable frequency drive. As a minimum, motors to have Class F insulation, winding insulation rated for 1000 volts and insulated bearings to prevent high frequency ground path. Loads not-to-exceed 80 percent of nameplate rating.
- F. Explosion-Proof Motors: UL approved and labelled for hazard classification with over temperature protection.
- G. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- H. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Coordinate conductor sizes with Division 26, Electrical. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- I. Provide inverter ready motors per NEMA MG1-30 for variable speed drive or soft-start starter use. Provide shaft grounding for motors over 2 HP serving variable speed drives. Provide shaft grounding and insulated bearings on motors 25 HP and larger serving variable speed drives. Shielded cable required for power wiring from variable speed drive to motor connection.

- J. Unless otherwise indicated, motors 1-HP and larger to meet/exceed NEMA Premium Efficiency and latest EPACT.
- K. Vertical in-line pump motors per NEMA MG1, Motors and Generators.

2.3 STARTERS

- A. Single-Phase Motors:
 - 1. Manual across-the-line starting switch having toggle-operated switch pilot running light and built-in thermal overload device with heating element rated not more than 115 percent motor full load current indicated on name plate of motor to be protected. Surface mount starters. Provide NEMA-1 enclosure.
 - 2. Overload relays to be melting alloy type with a replaceable control circuit module. Thermal units to be interchangeable. Starter to be non operative if thermal unit is removed.
 - 3. Single-phase motors with automatic controls. Provide motor-rated relay with coils rated for control voltage.
- B. Starters up to Size 8 to be suitable for the addition of a minimum of three external auxiliary contacts (normally open or normally closed). Contactor, coils and relays to perform the control functions of the associated equipment and control sequence.
- C. 3-Phase Motors up to and Including 15 HP:
 - 1. Provide enclosed type magnetic across-the-line starter with thermal overload and undervoltage protection.
 - 2. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified. Then provide "Hand-Off-Auto" selector switch.
 - 3. Starters for 3-phase motors to have overload protection in each of the three legs, with external manual reset.

2.4 VARIABLE FREQUENCY DRIVES

- A. Design: Solid state, with a Pulse Width Modulated (PWM) output waveform enclosed in a NEMA 1 enclosure, completely assembled and tested by manufacturer. Employ a full wave rectifier (to prevent input line notching), DC Line Reactor, capacitors, and Insulated Gate Bipolar Transistors (IGBTs) as the output switching device drive efficiency: 97 percent or better at full speed and full load. Fundamental Power Factor: 0.98 at all speeds and loads. Unit designed to feed two motors simultaneously.
- B. Specifications:
 - 1. Input 440/450/480/500VAC plus or minus 10 percent (capable of operation to 550VAC), 3-phase, 48 to 63Hz or Input 208/220/230/240VAC plus or minus 10 percent, 3-phase, 48 to 63Hz.
 - 2. Output 0 - Input Voltage, 3-phase, 0 to 500Hz for drives up to 75 HP; 0 to 120Hz for drives over 75 HP.
 - 3. Environmental Operating Conditions: 0 to 40C at 3kHz switching frequency, 0 to 3300-feet above sea level, less than 95 percent humidity, noncondensing.
 - 4. Enclosure rated Type 1.
- C. Standard Features:
 - 1. Provide VFDs with the same customer interface, including digital display, keypad and customer connections; regardless of horsepower rating. The keypad is to be used for

- local control (start/stop, forward/reverse, and speed adjust), for setting parameters, and for stepping through the displays and menus.
2. Fault Mode on Loss of Input:
 - a. Displaying a fault.
 - b. Running at a programmable preset speed as selected by user.
 3. Utilize English digital display (code numbers are not acceptable). Digital Display: A 40 character (2 line by 20 characters/line) LCD display, backlit to provide easy viewing in light condition, adjustable contrast to optimize viewing at angles display. Set-up parameters, indications, faults, warnings and other information in words to allow the user to understand what is being displayed without the use of a manual or cross reference table.
 4. Utilize preprogrammed application macro's specifically designed to facilitate start-up. Provide one command to reprogram parameters and customer interfaces for a particular application to reduce programming time.
 5. Automatic restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts to be programmable. If the time between reset attempts is greater than zero, the time remaining until reset occurs to count down on the display to warn an operator that a restart will occur.
 6. Capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
 7. Automatic extended power loss ride-through circuit.
 8. Customer terminal strip isolated from the line and ground.
 - a. Prewired three-position Hand-Off-Auto switch and speed potentiometer. When in "Off" the VFD will be stopped. When in "Auto" the VFD will start via an external contact closure, and its speed will be controlled via an external speed reference.
 9. Current Limit Circuits to Provide Trip Free Operation:
 - a. Slow current regulation limit circuit adjustable to 125 percent (minimum) of the VFDs variable torque current rating. Adjustment made via the keypad, and displayed in amps.
 - b. Rapid current regulation limit adjustable to 170 percent (minimum) of the VFDs variable torque current rating.
 - c. Current switch off limit fixed at 255 percent (minimum, instantaneous) of the VFDs variable torque current rating.
 10. Overload Rating: 110 percent of its variable torque current rating for 1 minute every 10 minutes, and 140 percent of its H torque current rating for 2 seconds every 15 seconds.
 11. DC Line Reactor to reduce the harmonics to the power line.
 12. Optimized for a 3 kHz carrier frequency to reduce motor noise.
 13. Manual speed potentiometer or keypad as a means of controlling speed manually.

D. Adjustments:

1. Five programmable critical frequency lockout ranges.
2. PI setpoint controller.
3. Two programmable analog inputs for reference for PI controller. Analog Inputs: Include filters; programmable from 0.01 to 10 seconds to remove oscillation in the input signal.
4. Six programmable digital inputs for maximum flexibility in interfacing with external devices.

5. Two programmable analog outputs proportional to frequency, motor speed, output voltage, output current.
 6. Two independently adjustable accel and decel ramps. Ramp times adjustable from 1 to 1800 seconds.
 7. The VFD to ramp or coast to a stop, as selected by user.
- E. Display: The following operating information displays to be standard on the VFD digital display.
1. Output Frequency
 2. Motor Speed (RPM, percent or engineering units)
 3. Motor Current
 4. Calculated Motor Torque
 5. Calculated Motor Power
 6. Output Voltage
 7. Analog Input Values
 8. Keypad Reference Values
 9. Elapsed Time Meter
 10. kWh Meter
- F. Protection Circuits: In the case of a protective trip, stop the drive and announce the fault condition.
1. Overcurrent trip 315 percent instantaneous (225 percent RMS) of the VFDs variable torque current rating.
 2. Overvoltage trip 130 percent of the VFD's rated voltage.
 3. Undervoltage trip 65 percent of the VFD's rated voltage.
 4. Overtemperature plus 70C (ACH 501); plus 85C (ACH 502).
 5. Ground Fault either running or at start.
 6. Adaptable Electronic Motor Overload (I2t).
- G. Speed Command Input Via:
1. Keypad.
 2. Two analog inputs, each capable of accepting a 0 to 20mA, 4 to 20mA, 0 to 10V, 2 to 10V signal. Analog inputs programmable filter to remove an oscillation of the reference signal. Minimum and maximum values (gain and offset) adjustable within the range of 0 to 20mA and 0 to 10V.
- H. Accessories:
1. Door interlocked thermal magnetic circuit breaker disconnect handle, through-the-door type, and padlockable in the "Off" position.
 2. Fused disconnects for each motor.
 3. Trouble output contact.
 4. Include a set of contacts that signal the building automation system to open VAV boxes to 100 percent during bypass mode.
 5. Output filter to provide for wave shaping.
 6. Provide 5 percent impedance 3-phase line reactor on the input side of the VFD.
- 2.5 DISCONNECTS
- A. Provided by Division 26, Electrical unless specified otherwise.

PART 3 - EXECUTION

3.1 GENERAL

- A. Electrical Requirements:
1. Contractor to Provide the Following:
 - a. Motors.
 - b. Starters and disconnects that are integral parts of plumbing equipment as shown on the equipment schedules. Reference Drawings and subsequent Sections. Provide a working system. Coordinate with Division 26, Electrical.
 - c. Low Voltage and Electronic Control Devices.
 - d. Low Voltage Transformers.
 - e. Low Voltage Conduit and Wire and Connecting Devices.
 - f. Conduit and wire for electronic devices, except for line voltage wiring.
 2. Electrical work listed above performed by a licensed electrical contractor or by the control manufacturer, but provided for and coordinated under Division 22, Plumbing work. In addition, controls work supervised and subsequently approved in writing by the control manufacturer.
 3. Contractor to furnish the following to the Electrical Contractor where applicable: Line voltage control equipment, including switches (except disconnects), time switches, transformers, relays, etc. (except those part of MCC).
 4. Include the Following Items under Division 26, Electrical Work:
 - a. Line voltage wire and conduit system.
 - b. Disconnects not provided with equipment.
 - c. Installation of line voltage control equipment supplied by Division 22.
- B. Electrical Interlocks: Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize mechanical equipment wiring diagrams to coordinate with the electrical systems so that proper wiring of the equipment involved is affected.
- C. Coordinate location of disconnect and starter or motor controller. Combination starter/disconnects may be used in lieu of separate items.
- D. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
- E. Provide inverter ready motors per NEMA MG1-30 for variable speed drive or soft-start starter use. Provide shaft grounding for motors over 2 HP serving variable speed drives. Provide shaft grounding and insulated bearings on motors 25 HP and larger serving variable speed drives. Shielded cable required for power wiring from variable speed drive to motor connection.
- F. Unless otherwise indicated, motors 1-HP and larger to meet/exceed NEMA Premium Efficiency and latest EPACT.
- G. Vertical in-line pump motors per NEMA MG1 vertical motor requirements.
- H. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- I. Check line voltage and phase and ensure agreement with nameplate.
- J. Verify motor rotation.
- K. Field Quality Control:

1. Prepare for Acceptance Tests as Follows:
 - a. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - b. Test interlocks and control features for proper operation.
 - c. Verify that current in each phase is within nameplate rating.
 2. Testing: Perform the Following Field Quality-Control Testing:
 - a. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
 - b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
 - a. Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with requirements.
 - b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - c. Verify bearing lubrication.
 - d. Verify proper motor rotation.
 - e. Test Reports:
 - 1) Prepare a written report to record the following test procedures used:
 - (a) Test results that comply with requirements.
 - (b) Test results that do not comply with requirements and corrective action taken to achieve compliance.
 - L. Adjusting: Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.
 - M. Cleaning:
 1. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
 2. Clean motors, on completion of installation, according to manufacturer's written instructions.
- 3.2 GENERAL MOTOR CONSTRUCTION AND REQUIREMENTS
- A. Motor Installation: Install in accordance with manufacturer's instructions. Coordinate with starter or variable speed controller with control sequence to provide necessary starter accessories.
- 3.3 STARTERS
- A. Install starters in accordance with manufacturer's instructions.
 - B. Coordinate disconnect requirements and location with Division 26, Electrical if not integral to starter. If starter is installed out of line of sight of motor, provide additional disconnect at motor per code.
 - C. Provide NEMA housing appropriate to installation location.
 - D. Provide supports and install securely, in neat and workmanlike manner, as specified in NECA 1.
 - E. Meet mounting height and accessible location requirements per local code.

- F. Provide fuses for fusible switches.
- G. Select and install overload heater elements in motor starters to match installed motor characteristics.
- H. Single phase 120 Volt starter: if not furnished as single packaged controller/disconnect, provide contactors, relays, wiring and devices necessary to match sequence of operation for equipment.

3.4 VARIABLE FREQUENCY DRIVES

- A. Variable Speed Controller Connection:
 - 1. Coordinate wiring length/type to meet controller manufacturer's requirements. Provide grounding per manufacturer's wiring diagram.
 - 2. Shaft Grounding:
 - a. Provide shaft grounding assembly on motors controlled by variable frequency drive. Shaft grounding device to be in the form of brush that resides on the motor shaft. Brush assembly to be capable of tolerating misalignment and maintaining rotating contact throughout the motor's life.
 - b. Material: Material used in the grounding assembly to be of stable material commonly used within industry that is not believed to constitute a hazardous material under Occupational Safety and Health Administration (OSHA) regulations.
 - c. Brushes: Specifically developed carbon compounds of sustained performance with seal life expectancy of three years minimum.
 - d. Seals: Sealed type to keep contaminants from entering the shaft grounding system in wet or severe environment applications.
 - e. Shaft Grounding Assembly: For clean room air handling systems, use the type that contains the wear products within a special enclosure within the shaft grounding system.
 - f. Shaft grounding assembly installation not to affect the motor manufacturer warranty. Where the severe environment conditions require application of the shaft grounding types that are screwed into the motor shaft, the installation of the shaft grounding system performed either by the motor manufacturer or by the motor manufacturer authorized facility.
 - g. Bond the brush to the closest ground point using code sized green insulated stranded copper conductor per manufacturer instructions.
 - h. Test and verify the performance of the assembly to ensure that under no conditions the shaft exceeds three volts.
 - 3. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
 - 4. Check line voltage and phase and ensure agreement with nameplate.
 - 5. Verify motor rotation.
- B. Ensure the area where the variable frequency drive is to be installed is within the range of ambient temperatures set by the manufacturer.
- C. Ensure grounding and bonding is per manufacturers recommendations.
- D. Install per manufacturer's recommendations.
- E. Install per NEC requirements.
- F. Coordinate with Division 26, Electrical.

3.5 DISCONNECTS

- A. Provided by Division 26, Electrical unless specified otherwise.
- B. Provide disconnecting means within sight of each motor controller and of each motor. Motor controller disconnecting means equipped with lock-out/tag-out padlock provisions do not require a disconnect switch at the controlled motor location. Locate disconnect means in view of and not inside of equipment, such that tools are not needed to remove covers to access the disconnecting means.
- C. Install in accordance with manufacturer's instructions.
- D. Install fuses in fusible disconnect switches. Coordinate fuse ampere rating with installed equipment. Do not provide fuses of lower ampere rating than motor starter thermal units.
- E. Controllers:
 - 1. Single Phase 120 Volt Starter: If not furnished as single packaged controller/disconnect, provide contactors, relays, wiring and devices necessary to match sequence of operation for equipment.

END OF SECTION

SECTION 220519 - PLUMBING DEVICES**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Pressure Gauges
 - 2. Thermometers
 - 3. Water Hammer Arrestors (Shock Absorbers)
 - 4. Water Filters

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Pressure Gauges:
 - 1. Dwyer Instruments, Inc.
 - 2. Moeller Instrument Co., Inc.
 - 3. Omega Engineering, Inc.
 - 4. Terice
 - 5. Or approved equivalent.
- B. Thermometers:
 - 1. Ashcroft
 - 2. Terice
 - 3. Weiss
 - 4. Marshaltown
 - 5. Weksler
 - 6. Or approved equivalent.
- C. Water Hammer Arrestors (Shock Absorbers):
 - 1. Bellows Type:

- a. Amtrol
 - b. J.R. Smith
 - c. Wade
 - d. Zurn
 - e. Or approved equivalent.
2. Piston Type:
 - a. PPP
 - b. Sioux Chief
 - c. Or approved equivalent.
- D. Water Filters:
1. Cuno
 2. Or approved equivalent.
- ## 2.2 PRESSURE GAUGES
- A. Pressure Gauges: ASME B40.100, phosphor-bronze bourdon type, dry type.
1. Case: Cast aluminum, stem-mounted, flange less.
 2. Size: 4-1/2-inch diameter.
 3. Window: Clear glass.
 4. Connector: Brass.
 5. Scale: White aluminum with black graduation and markings.
 6. Pointer: Black, adjustable.
 7. Mid-Scale Accuracy: One percent.
 8. Scale: PSI and KPa.
 9. Basis of Design: Trerice Model 600CB.
- ## 2.3 THERMOMETERS
- A. Thermometers - Adjustable Angle: Red or blue appearing organic liquid in glass, ASTM E 1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9-inch scale.
 2. Window: Acrylic.
 3. Scale: Aluminum, white background, black graduations and markings.
 4. Stem: 3/4-inch NPT brass (aluminum for installation in air ducts).
 5. Accuracy: 2 percent, per ASTM E 77.
 6. Calibration: 0-160 with 2 Degrees F graduations.
 7. Basis of Design: Trerice BX9.
- ## 2.4 WATER HAMMER ARRESTORS (SHOCK ABSORBERS)
- A. Bellows-type, stainless steel casing and bellows, pressure rated, tested and certified in accordance with PDI WH-201 or ASSE 1010.
- B. Piston-type, copper, brass or stainless steel with O-ring piston, pressure rated, tested and certified in accordance with PDI WH-201 or ASSE 1010.
- ## 2.5 WATER FILTERS
- A. Wound-type micronic filter with disposable cartridge. Provide 1 additional set of cartridges for each filter.

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

- A. For plumbing devices requiring access from access panels (i.e. trap primers, water hammer arrestors and the like) submit location/size of all access panels to Architect for approval prior to purchase and installation of access panel. See Section 22 00 00, Plumbing Basic Requirements for additional requirements.
- B. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- C. Install per manufacturer recommendations.

3.2 PRESSURE GAUGES

- A. Install pressure gauge where exposure to heat and vibration are minimal and where the dial can be easily read. It is also important to install the gauge in a location with undisturbed and continuous flow of the pressure medium.
- B. Provide a needle valve or gauge cock, installed between the process and the pressure gauges.
- C. Install pressure gauges in piping tee with pressure gauge cock, in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- D. Locations: Install in the following locations, and elsewhere as indicated.
 - 1. At each pump inlet and outlet.
 - 2. At inlet and discharge of each pressure reducing valve.
 - 3. At make-up water service outlets.
 - 4. At inlets and outlets of all master mixing valves.
- E. Adjust gauges to final angle, clean windows and lenses, and calibrate to zero.
- F. Install per manufacturer recommendations.
- G. Pressure Gauge Range/Graduations:
 - 1. Cold Water: 0-100 PSI; graduation 1 PSI
 - 2. Hot Water: 0-100 PSI; graduation 1 PSI

3.3 THERMOMETERS

- A. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2-inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- B. Install thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- C. Adjust thermometers to final angle, clean windows and lenses, and calibrate to zero.
- D. Install per manufacturer recommendations.
- E. Thermometer Range/Graduations:
 - 1. Cold Water: 25-125 degrees F; graduation 1 degree F
 - 2. Hot Water: 30-240 degrees F; graduation 2 degrees F

3.4 WATER HAMMER ARRESTORS (SHOCK ABSORBERS)

- A. Install in upright position, in locations and of sizes in accordance with PDI WH-201 or ASSE 1010, and elsewhere as indicated.

- B. Locate shock absorbers in supply pipe in accordance with recommendations of Plumbing and Drainage Institute PDI-WH201 or ASSE 1010. Install ahead of solenoid operated valves. Determine size of absorber by fixture unit value of fixture supplied, using PDI symbols to designate sizes. Provide access panel for each shock absorber.
- C. Install per manufacturer recommendations.

3.5 WATER FILTERS

- A. Attach the mounting bracket to the filter head with screws.
- B. Install filter cartridge into filter head. Position filter bracket by holding it up against the mounting surface. Allow at least 2-inches of clearance below the cartridge to facilitate cartridge removal. Mark the mounting hole locations onto the mounting surface. Secure bracket to mounting surface using appropriate mounting hardware. The unit may be mounted either vertically or horizontally. The inlet/outlet connections are typically female pipe threads. Appropriate fittings/piping/tubing tools vary by requirements of each installation. Shut-off valves must be installed on both the inlet and outlet water lines. Be sure to always use Teflon Tape to seal tapered threads. Important: Do not use acid base pipe sealers or wicking on plastic filter head.
- C. Make any required connections and pressurize system to check for leaks. If none are apparent, flush new cartridge for a minimum of five minutes to remove any trapped air or carbon fines. The filter system is now ready for service.
- D. Install per manufacturer recommendations.

END OF SECTION

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Valves, General
 - 2. Balancing Valves
 - 3. Ball Valves
 - 4. Swing Check Valves
 - 5. Backflow Prevention Assemblies
 - 6. Pressure Regulating Valve-Domestic Water
 - 7. Thermostatic Master Mixing Valves (ASSE 1017 Rated)
 - 8. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated)

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NSF 61, Annex G and/or NSF/ANSI 372 for potable water services. Valves must be 3rd-party certified.
 - 2. ISO 9001 Certified.
 - 3. IAPMO Certified for Low Lead.
- C. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.
- D. Model numbers indicated as Basis-of-Design indicate valve characteristics. All valves are to meet code Low Lead/Lead Free Standards.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.

- B. Valves, General:
 - 1. Apollo
 - 2. Armstrong
 - 3. ASCO
 - 4. Caleffi
 - 5. Cla-Val
 - 6. Conbraco
 - 7. Crane
 - 8. Clow
 - 9. Griswold
 - 10. Hammond
 - 11. Hays
 - 12. Jenkins
 - 13. Josam
 - 14. Kennedy
 - 15. Milwaukee
 - 16. Mueller
 - 17. Nibco
 - 18. Red-White Valve
 - 19. Smith
 - 20. Stockham
 - 21. Tour Anderson
 - 22. Wade
 - 23. Watts
 - 24. Wilkins
 - 25. Zurn
 - 26. Or approved equivalent.
- C. Balancing Valves:
 - 1. Caleffi
 - 2. Griswold
 - 3. Hays
 - 4. Armstrong CBV
 - 5. Tour Anderson
 - 6. Or approved equivalent.
- D. Ball Valves:
 - 1. See Valves General above.
 - 2. NSF Valves:
 - a. Clow
 - b. Kennedy
 - c. Nibco
 - d. Or approved equivalent.
- E. Swing Check Valves:
 - 1. See Valves General above.
- F. Backflow Prevention Assemblies:
 - 1. Backflow Preventers:

- a. Apollo
 - b. Cla-Val
 - c. Conbraco
 - d. Watts
 - e. Or approved equivalent.
2. Backflow Prevention Assemblies - Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications - 2-inches and Smaller:
 - a. Febco 860-with 650A.
 - b. Conbraco 40-210-AGD.
 - c. Wilkins 375-XL-SAG.
 - d. Watts 919-QT-S valve with 919AGC or 919AGF.
 - e. Or approved equivalent.
 3. Backflow Prevention Assemblies - Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications - 2-1/2-inches and Larger:
 - a. Febco 860 with 758A.
 - b. Conbraco Apollo 40-700 with 758A.
 - c. Watts 909-S-NFA-NRS with AGC.
 - d. Wilkins 375-FSC.
 - e. Or approved equivalent.
 4. Backflow Prevention Assemblies - Double Check Valve Assembly (DCVA) for Low Hazard Applications - 2-inches and Smaller:
 - a. Febco 850-650A
 - b. Conbraco Apollo 40-110-T2
 - c. Watts 007-QT-FDA-S
 - d. Wilkins 350-S-XL
 - e. Or approved equivalent.
 5. Backflow Prevention Assemblies - Double Check Valve Assembly (DCVA) for Low Hazard Applications - 2-1/2-inches and Larger:
 - a. Conbraco Apollo 45-11-1
 - b. Watts LF-709 with 77F-01-FDA-12
 - c. Or approved equivalent.
 6. Spill Resistant Pressure Vacuum Breaker:
 - a. Febco
 - b. Conbraco
 - c. Watts
 - d. Wilkins
 - e. Or approved equivalent.
 7. Atmospheric Vacuum Breakers:
 - a. Febco
 - b. Conbraco
 - c. Watts
 - d. Wilkins
 - e. Or approved equivalent.
- G. Pressure Regulating Valve-Domestic Water:
1. Cash Acme
 2. Cla-Val

3. Watts
 4. Wilkins
 5. Or approved equivalent.
- H. Thermostatic Master Mixing Valves (ASSE 1017 Rated):
1. Caleffi
 2. Holby Tempering Valve
 3. Lawler Series 66
 4. Leonard Type TM
 5. Powers LFMM430 (Lead Free)
 6. Symmons Temp Control Series 5
 7. Or approved equivalent.
- I. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated):
1. Caleffi
 2. Lawler
 3. Leonard
 4. Watts
 5. Powers Hydroguard
 6. Or approved equivalent.

2.2 VALVES - GENERAL

- A. General:
1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
 2. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6-inches and smaller. Provide gear operators for quarter-turn valves 8-inches and larger and plug valves installed over 5-feet above finished floor.
 3. Valve Identification: Manufacturer's name (or trademark) and pressure rating clearly marked on valve body.
- B. Valves in Insulated Piping: With 2-inch stem extension and following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation on valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.
- C. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Solder Joint: With sockets according to ASME B16.18.
 3. Threaded: With thread according to ASME B1.20.1.
- D. Valve Bypass and Drain Connections: MSS SP-45.
- E. Building Service:
1. Shutoff and Isolation Valves:
 - a. Pipe Sizes 3-inches and Smaller: Ball Valve.
 2. Drain Service: Ball Valves.
 3. Strainer Blow-Off: Ball Valve.
 4. Check Valves: Swing.

2.3 BALANCING VALVES

- A. Maximum 125 PSIG System Working Water Pressure.
- B. Manual Set Balancing Valves:
 - 1. Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
 - a. Precise flow measurement.
 - b. Precision flow balancing.
 - c. Positive drip-tight shut-off.
 - 2. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators located on the valve handwheel. Valves have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valves to be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi to have two 1/4-inch threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves to be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug to be brass. The handwheel to be high-strength resin.
 - 3. 2-1/2-inch and Larger: Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
 - a. Precise flow measurement.
 - b. Precision flow balancing.
 - c. Positive drip-tight shut off. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators location on the valve handwheel. Valves to have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valve body to be either cast iron with integrated cast iron flanges (2-1/2-inch to 12-inch) or ductile iron with industrial standard grooved ends (2-1/2-inch to 12-inch). Valve stem and plug disc to be bronze with handwheel that permits multi-turn adjustments. Sizes 2-1/2-inch and 3-inch: five turns; sizes 4-inch to 6-inch: 6 turns; sizes 8-inch to 10-inch: 12 turns; and size 12-inch: 14 turns. Flange adapters to be provided to prevent rotation.

2.4 BALL VALVES

- A. All ball valves on brazed piping are to be three-piece.
- B. 2-1/2 Inches and Smaller: MSS SP-110, 400-600 PSI, two-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 77CLF 100 Series two-piece.
- C. 3 Inches and Larger: MSS SP-110, 400-600 PSI, three-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 82-100/82A 140 Series three-piece.

2.5 SWING CHECK VALVES

- A. 2-inches and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc. Nibco 413. MSS SP-80.
- B. 2-1/2-inches and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Nibco F918. MSS SP-71.
- C. Rubber Flapper Check Valve: Horizontal or vertical upward flow installation. Working pressure to 175 PSI. Ductile iron or cast iron body. Steel reinforced Buna-N rubber flapper epoxy coating on wetted parts. MSS SP-80.
- D. Gruvlok Series 7800 Check Valve: Horizontal installation. Working pressure to 300 PSI, Type 304/302 Stainless Steel conforming to ASTM 167. Ductile body, ASTM A536, and stainless clapper, EPDM, nitrile or optional viton bumper and bonnet seals. Stainless wetted parts.

2.6 BACKFLOW PREVENTION ASSEMBLIES

- A. General: Assemblies model numbers listed below are for general comparison. Project specific model numbers to be verified contractor as approved by jurisdiction where project is located.
- B. Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications:
 - 1. 2-inches and Smaller: Assembly consists of shutoff ball valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and pressure-differential relief valve located between two positive seating check valves and comply with requirements of ASSE Standard 1013 and AWWA C511. Bronze construction, threaded ends, stainless steel internal parts, FDA strainer, and air gap fitting. Route pipe from air gap fitting to approved waste receptor.
 - 2. 2-1/2-inches and Larger: Assembly consists of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and pressure-differential relief valve located between two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C511. Epoxy coated cast iron body construction, flanged ends, stainless steel internal parts, bronze seats, and FDA strainer.
- C. Double Check Valve Assembly (DCVA) for Low Hazard Applications:
 - 1. 2-inches and Smaller: Assembly consists of shutoff ball valves in inlet and outlet, and FDS strainer on inlet. Assemblies include test cocks and two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C510. Bronze construction, threaded ends, and stainless steel internal parts.
 - 2. 2-1/2-inches and Larger: Assembly consists of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C510. Epoxy coat cast iron body construction, strainer flanged ends, and stainless steel internal parts.
- D. Spill Resistant Pressure Vacuum Breaker: Watts Model 800MCQT with 777S "Y" strainer.
- E. Atmospheric Vacuum Breaker: Assembly consists of a bronze vacuum breaker body with silicone disc, and full size orifice. Device to be IAPMO listed, meet ASSE standard 1001, and ANSI standard A113.1.1 rough chrome plate finish.

2.7 PRESSURE REGULATING VALVE-DOMESTIC WATER

- A. Water: Bronze body, diaphragm or piston type, spring actuated, with separate or integral stainless steel strainer, pressure range to suit conditions, approved for potable water use, low lead. Provide shutoff valves, pressure relief valves, unions, drain valve and bypass.
- B. Water: Automatic control pressure regulating valve, stainless steel seat, stem and spring, diaphragm actuated with brass body, hydraulic control pilots with effluent operating temperature range 32 degrees F to 180 degrees F, FDA and AWWA approved.
- C. Water: Bronze body construction, stainless steel strainer screen, thermal expansion bypass with renewable stainless steel seat and high temperature resisting diaphragm.

2.8 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED)

- A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1017.
- B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.
- C. Flow from the tempered water circulating pump to be split to mixing valve and building hot water heating system.

2.9 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED)

- A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1070.
- B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
 - 4. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Inspect the shipping container before unpacking to look for damage that could have occurred during transport, and report it to the transportation company immediately. After visual inspection, remove the valve from the shipping container. Make sure the faces are free of any scratches and that there is not any obvious damage to the actuator assembly or valve body.
- D. Make sure to note the valve's model number during the unpacking process. The model number will need to be provided when purchasing replacement parts.
- E. Purge and clean all piping to be connected to valve.

- F. Install per manufacturer's recommendations.
- G. Determine that the valve and its plumbing piping is adequately supported when installed. If a valve is not adequately supported, this could prevent the valve from operating and sealing correctly. Be sure that all mating flanges are in line and parallel to minimize straining on joints and valve body.
- H. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- I. Do not attempt to repair defective valves; replace with new valves.
- J. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
- K. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose end adapter and cap on chain for each valve that must be installed with stem below horizontal plane. Ensure installation provides full stem movement.
- L. Insulation: Where insulation is indicated, install extended stem valves, arranged in proper manner to receive insulation.
- M. Mechanical Actuators: Install with chain operators where indicated. Extend chains to 5-feet above floor and hook to clips to clear aisle passage.
- N. Stem Selection: Outside screw and yoke stems, except provide inside screw, non-rising stem where space prevents full opening of OS&Y valves.
- O. Seats: Renewable seats, except where otherwise indicated.
- P. When soldering, use paste flux that are approved by the manufacturer for use with lead free alloys.
- Q. If valve applications are not indicated on Drawings, use the following:
 - 1. Shutoff Service: Ball valves.
- R. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- S. Valves, except wafer/butterfly types, with the following end connections:
 - 1. For Copper Tubing, 2-inches and Smaller. Threaded ends except where solder-joint valve-end.
 - 2. For Copper Tubing, 2-1/2-inches to NPS 4-inches. Flanged ends except where threaded valve-end.
 - 3. For Copper Tubing: 5-inches and Larger: Flanged ends.
 - 4. For Steel Piping, 2-inches and Smaller: Threaded ends.
 - 5. For Steel Piping, 2-1/2-inches to NPS 4-inches: Flanged ends except where threaded valve-end.
 - 6. For Steel Piping, 5-inches and Larger: Flanged ends.
- T. Valve Adjusting and Cleaning:
 - 1. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.
 - 2. Valve Identification. Tag valves per Section 22 05 53, Identification for Plumbing Piping and Equipment.

3.2 BALANCING VALVES

- A. See General Installation Requirements above.
- B. Install with flow in the direction of the arrow on the valve body and installed at least five pipe diameters downstream from any fitting, and at least ten pipe diameters downstream from any pump. Two pipe diameters downstream from the balancing valve should be free of any fittings. When installed, easy and unobstructed access to the valve handwheel and metering ports for adjustment and measurement are to be provided. Mounting of valve in piping must prevent sediment build-up in metering ports.

3.3 BALL VALVES

- A. See General Installation Requirements above.

3.4 SWING CHECK VALVES

- A. See General Installation Requirements above.
- B. Swing Check Valve Installation: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow. Only install where there are 10 pipe diameters of straight pipe upstream of valve.
- C. Ejector and Sump Pump-Discharge Check Valves:
 - 1. 2-inches and Smaller: Bronze swing or spring-loaded lift check valves with bronze disc.
 - 2. 2-1/2-inches and Larger: Rubber flapper swing check valves with lever and weight.
- D. Domestic Water and Circulation Pump Discharge Check Valves:
 - 1. 2-inches and Smaller: Bronze body, spring loaded, lead free, lift check.
 - 2. 2-1/2-inches and Larger: Wafer style, silent lift check valve, lead free.

3.5 BACKFLOW PREVENTION ASSEMBLIES

- A. See General Installation Requirements above.
- B. Install where indicated, and where required by code. Where practical, locate in same room as equipment being protected.
- C. Submit product cut sheets to local AHJ for approval prior to purchase and installation.
- D. Install as close to wall as possible with clearances for access and maintenance as required by AHJ.
- E. Coordinate exact location of installation and type of backflow device serving a particular piece of equipment with AHJ and Architect prior to purchase and installation.
- F. Provide wall/floor brackets that are of fully welded, hot dipped galvanized construction, fabricated to meet field conditions. Mount backflow preventer to brackets using cadmium plated "U" type bolts and nuts.
- G. Contact local water district/backflow specialist and request backflow installation requirements. Install backflow devices per UPC and local water district/backflow specialist requirements.
- H. Route waste piping from air gap waste fitting concealed within walls to point of air gap termination at indirect waste receptor.
- I. Follow local codes for installation requirements. Pipe lines should be thoroughly flushed to remove foreign material before installing the unit. Provide a strainer ahead of backflow preventer to prevent disc from unnecessary fouling. Install valve in line with arrow on valve

body pointing in the direction of flow. It is important that the valve be easily accessible to facilitate testing and servicing. Do not install in a concealed location.

3.6 PRESSURE REGULATING VALVE-DOMESTIC WATER

- A. See General Installation Requirements above.
- B. Install valve in the line with arrow on valve body pointing in the direction of flow. This valve should be installed where it is accessible with sufficient clearance for cleaning, service or adjustment. Install the reducing valve before a sill cock line if possible. Before installing the reducing valve hose bibb, flush out the line to remove loose dirt and scale which might damage valve disc and seat.
- C. Horizontal installation is recommended. However, valve can be installed in a vertical position. Regulator must be installed in an accessible location to facilitate servicing the regulator.
- D. To readjust reduced pressures, loosen adjusting screw nut and turn adjusting screw clockwise to raise reduced pressure and counterclockwise to lower reduced pressure.
- E. When reducing valve is used, it makes a closed system; therefore, pressure relief protection must be provided on the downstream side of the reducing valve to protect equipment.
- F. Provide pressure relief valve and terminate discharge to indirect waste receiver.
- G. Anytime a reducing valve is adjusted, the use of a pressure gauge is recommended to verify correct pressure setting. Do not bottom out adjusting screw or spring cage.
- H. Provide inlet and outlet ball valves, and globe valve bypass. Provide pressure gauge on valve outlet.
- I. Provide pressure relief valve piped full size to indirect waste receiver or floor drain.
- J. Provide factory startup on automatic control valves.

3.7 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED)

- A. See General Installation Requirements above.
- B. Install mixing valve per manufacturer's instruction manual.

3.8 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED)

- A. See General Installation Requirements above.
- B. Install mixing valve per manufacturer's instruction manual.

END OF SECTION

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Pipe Hangers and Supports for Plumbing Piping and Equipment
 - 2. Wall and Floor Sleeves
 - 3. Building Attachments
 - 4. Flashing
 - 5. Miscellaneous Metal and Materials

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. ASCE 7-16, Minimum Design Loads for Buildings and Other Structures.
 - 2. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.
 - 3. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
 - 4. Install piping per SMACNA's requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

- A. General - Provide pipe and equipment hangers and supports in accordance with the following:
 - 1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for piping are not shown on the Drawings, the contractor is responsible for their design.
 - 2. Connections to structural framing are not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems:

1. Support frames such as pipe racks or stanchions for piping and equipment which provide support from below.
2. Equipment and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.
- D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.
- E. Provide seismic restraint hangers and supports for piping and equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pipe Hangers and Supports for Plumbing Piping and Equipment:
 1. Pipe Hangers/Supports:
 - a. B-Line Systems, Inc.
 - b. Anvil International
 - c. HOLDRITE
 - d. Erico Co., Inc.
 - e. Snappitz Thermal Pipe Shield Manufacturing
 - f. Rilco Manufacturing Co. Inc.
 - g. Nelson-Olson Inc.
 - h. Or approved equivalent.
 2. Channel Support Systems:
 - a. B-Line Systems, Inc.
 - b. Anvil International, Anvit-Strut
 - c. Erico Hanger Co., Inc.; O-Strut Div.
 - d. Unistrut Corp.
 - e. HOLDRITE EZ-Strut Systems
 - f. Or approved equivalent.
 3. Thermal-Hanger Shield Inserts:
 - a. Erico Hanger Co., Inc.
 - b. Pipe Shields, Inc.
 - c. Rilco Manufacturing Co., Inc.
 - d. HOLDRITE Insulation Couplings
 - e. Or approved equivalent.
 4. Freestanding Roof Supports:
 - a. Erico Hanger Co., Inc.
 - b. Nelson-Olsen Inc.
 - c. B-Line
 - d. M. Fab
 - e. Or approved equivalent.
 5. Pipe Alignment and Secondary Supports:
 - a. HOLDRITE
 - b. Starquick

- c. Or approved equivalent.
 - B. Wall and Floor Sleeves:
 - 1. Below Grade and High Water Table Areas:
 - a. Modular Link Sealing System at Pipe Sleeves:
 - 1) Thunderline Corporation
 - 2) Or approved equivalent.
 - 2. Pre-Engineered Firestop Pipe Penetration Systems:
 - a. HOLDRITE HydroFlame
 - b. Proset
 - c. Or approved equivalent.
 - C. Building Attachments:
 - 1. Anchor-It
 - 2. Gunnebo Fastening Corp.
 - 3. ITW Ramset/Red Head
 - 4. Masterset Fastening Systems, Inc.
 - 5. Or approved equivalent.
 - D. Flashing:
 - 1. Fastenal
 - 2. Or approved equivalent.
 - E. Miscellaneous Metal and Materials:
 - 1. See Miscellaneous Metal and Materials article below.
 - 2. Powder-Actuated Fastener Systems:
 - a. Gunnebo Fastening Corp.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head.
 - d. Masterset Fastening Systems, Inc.
 - e. Or approved equivalent.
- 2.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
- A. Horizontal Piping Hangers and Supports - Horizontal and Vertical Piping, and Hanger Rod Attachments:
 - 1. Factory fabricated horizontal piping hangers and supports to suit piping systems in accordance manufacturer's published product information.
 - 2. Use only one type by one manufacturer for each piping service.
 - 3. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping.
 - 4. Provide copper-plated hangers and supports for uninsulated copper piping systems.
 - 5. Provide padded pipe hangers, clamps and supports for thermoplastic piping system.
 - 6. Install no hub cast iron pipe and fittings per CISPI 301-09 Installation Procedures for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain Waste and Vent Piping Applications. Brace hubless cast iron pipe and fittings 5-inch and larger with HOLDRITE No Hub Pipe Restraints or approved equivalent.
 - B. Pipe Hangers, Guides and Channel Systems:
 - 1. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or

- cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
2. Hanger Rod Couplings: Malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
 3. Pipe Rings for Hanger Rods: Pipe sizes 2-inch and smaller, MSS SP Type 6 or Type 10, or approved equivalent. Pipe sizes 2-1/2-inches and larger, clevis type hangers with adjustable nuts on rod. MSS SP Type 1. Pipe rings to have same finish as hanger rods.
 4. Pipe Slides: Type 35 reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resist corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.
 5. Pipe Guides:
 - a. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Any contact with chilled water pipe is not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - b. Furnish and install guides approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.
 6. Channel Type Pipe Hanging System: Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A1011 GR33; one side of channel to have a continuous slot with in-turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
- C. Pipe Saddles and Shields:
1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
 2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
- D. Thermal-Hanger Shield Inserts: 100-PSI (690-kPa) minimum compressive strength insulation, encased in sheet metal shield.
1. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.
 2. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate.
 3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 4. For Clevis or Band Hanger: Insert and shield to cover lower 180 degrees of pipe.
 5. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
 6. Thermal Hanger Shield Inserts should be provided at the hanger points and guide locations on pipes requiring insulation. The Inserts should consist of Polyisocyanurate (urethane or phenolic insulation) encircling the entire circumference of the pipe with a 360 degree PVC (1.524 mm thick) with a living hinge and J lock and installed during the installation of the piping system.
- E. Roller Hangers:
1. Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.

- F. Concrete Inserts:
 - 1. Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.
- G. Continuous Concrete Insert:
 - 1. Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
- H. Beam Clamps:
 - 1. MSS Type 19 and 23, wide throat, with retaining clip.
 - 2. Universal Side Beam Clamp: MSS Type 20.
- I. Below Ground:
 - 1. Pipe Hangers: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 316. MSS Type 1. If PVC piping to be used, provide Type 1 hanger, coated for PVC piping.
 - 2. Rod: 5/8-inch stainless steel Type 316.
 - 3. Eyebolt: Stainless steel Type 316.
 - 4. Nuts and Washers: Stainless steel Type 316.
- J. Hangers for Pipe Size 2-inches and Smaller:
 - 1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.
- K. Hangers for Pipe Size 2-1/2-inches and Larger:
 - 1. Adjustable clevis type, UL listed, Type 1.
- L. Riser Clamps:
 - 1. Steel, UL listed. MSS Type 8.
- M. Plumbers Tape:
 - 1. Not permitted as pipe hangers or pipe straps.
- N. Pipe Alignment and Secondary Support Systems:
 - 1. Secondary Pipe supports for general applications (Non-Acoustical).
 - a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
 - b. Supports may be used when sound and/or vibration transfer is not a concern.
 - 2. Secondary pipe supports for sound and vibration attenuation (Acoustical).
 - a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
 - b. Acoustical pipe supports will be manufactured and installed in compliance with International Organization for Standardization (ISO) 3822-1 with current amendments.
 - c. Supports will be used when sound and/or vibration transfer is a concern. Locations where acoustical supports will be provided and include but are not limited to partition walls between living units, tenant spaces, retail units, mechanical rooms and lobbies.
 - d. Support Products:
 - 1) Support to Wall Brace and Wall Stud Penetrations: HOLDRITE #261, #262, #263, and #264, or approved equivalent.
 - 2) Pipe Wrap for Pipe Clamps and Channel-Mounted Pipe Clamps: HOLDRITE #270, or approved equivalent.

- 3) Pipe Wrap for Pipe Hangers: HOLDRITE #271, #272-2, and #272-4, or approved equivalent.
- 4) Drop-Ear Fitting Support: HOLDRITE #265, or approved equivalent.
- 5) Floor Riser Isolation Pads: HOLDRITE #275-T, or approved equivalent.
- 6) Floor Isolation Pads (General Applications): HOLDRITE #274, #275, #276, and #278, or approved equivalent.

O. Freestanding Roof Pipe Supports:

1. Polyethylene high-density U.V. resistant quick "pipe" block with foam pad.
2. Recommended installation is for pipe blocks to be freestanding.
3. Piping 3-inches and larger mounted on block type supports.

2.3 WALL AND FLOOR SLEEVES

A. Below Grade and High Water Table Areas:

1. Modular Link Sealing System at Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal. Use a modular link sealing system at sleeves to continuously fill the annular space between the pipe and the wall opening. Provide Link-seal Type C unless otherwise noted. OS with S-316 stainless construction for continuous water/tank walls.
2. Sleeves through concrete foundation walls and floors. Ductile iron pipe. Class 50 or 51 pipe conforming to ANSI/AWWA C151/A21.51. Pipe sleeve will extend a minimum of 6-inches beyond outside perimeter of foundation. Final placement of sleeve will be confirmed with project's structural engineer. In areas with a high water table, provide AWWA C900, Class 235 plastic pipe in lieu of ductile iron pipe.

B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.

C. Insulating Caulking: Eagle or Pitcher Super 66 high temperature cement.

D. Fabricated Accessories:

1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide following minimum gauges for sizes indicated:
 - a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
 - b. Sleeve Sizes 5-inches to 6-inches: 16 gauge.
 - c. Sleeve Sizes 7-inches and Larger: 14 gauge.
 - d. Fire-Rated Safing Material:
 - 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
 - 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.4 BUILDING ATTACHMENTS

- A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project Structural Engineer. Provide anchor bolts suitable for cracked concrete.

- B. Anchor Bolts:
 - 1. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 - 2. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 - 3. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.
- C. Beam Clamps:
 - 1. MSS Type 19 and 23, wide throat, with retaining clip.
 - 2. Universal Side Beam Clamp: MSS Type 20.
- D. Powder-Actuated Drive Pin Fasteners:
 - 1. Powder-Actuated Drive-Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- E. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- F. Grout: ASTM C1107, Grade B, factory mixed and packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, noncorrosive, and non-gaseous.
 - 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

2.5 FLASHING

- A. Steel Flashing: 26 gauge galvanized steel.
- B. Safes: 8 mil thick neoprene.
- C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.
- D. Provide hot dipped galvanized components for items exposed to weather.

2.6 MISCELLANEOUS METAL AND MATERIALS

- A. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings, that are necessary for completion of the project. The Contractor is responsible for their design.
 - 1. Fabricate miscellaneous units to size, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.

- C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods and equipment required for fabrication.
- G. Provide hot dipped galvanized components for items exposed to weather.
- H. Use straps, threshold rods and wire with sizes required by SMACNA to support piping.
- I. Grout: ASTM C1107, Grade B, factory mixed and packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, noncorrosive, and non-gaseous.
 - 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Examination:
 - 1. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.
- B. Preparation:
 - 1. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.
- C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate with project structural engineer proper placement of inserts, anchors and other building structural attachments.

3.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- A. Hangers and Supports:
 - 1. Comply with MSS SP-58. Pipe Hanger and Support Installation: Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.
 - 2. Pipe Ring Diameters:
 - a. Uninsulated and Insulated Pipe, except where oversized pipe rings are specified: Ring inner diameter to suit pipe outer diameter.
 - b. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.

3. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.
4. Pipe Support Brackets: Support pipe with pipe slides.
5. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.
6. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 - a. Field assemble and install according to manufacturer's written instructions.
7. Pipe Guides:
 - a. Install on continuous runs where pipe alignment must be maintained. Provide a minimum of two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Any contact with chilled water pipe should not permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - b. Install approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.
8. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field -fabricated, heavy-duty trapezes.
 - a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - b. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1
9. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers.
10. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.
11. Do not support piping from other piping.
12. Fire protection piping will be supported independently of other piping.
13. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
14. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.
15. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchor, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.
16. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
17. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.
18. Insulated Piping: (comply with the following)
 - a. Attach clamps and spacers to piping.
 - 1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - 2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

- 3) Do not exceed pipe stress limits according to ASME B31.9.
 - b. Install MSS SP-58, Type 39 protection saddles, if insulation without a vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
 - c. Install MSS SP-58, Type 40 protective shields on cold piping having a vapor barrier. Shields to span arc of 180 degrees.
 - 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
 - d. Shield Dimensions for Pipe, not less than the following:
 - 1) NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
 - 2) NPS 4 (DN100): 12-inches long and 0.06-inch thick.
 - 3) NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
 - 4) NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
 - 5) NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
 - e. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
 - f. Insert Material: Length at least as long as protective shield.
 - g. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
19. Equipment Clearances: Do not route equipment or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-foot lateral clearance from all sides of electric switchgear panels. Do not route piping or equipment above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact equipment or pipe routing to provide proper clearance with such items.
20. Pipe supports and hanger spacing (pipe supported from structure or floor-supported) to meet the requirements of References and Standards Article in Part 1 above.
- B. Pipe Curb Assemblies:
1. Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., piping, electrical power and control wiring). Meet requirements of roof warranty.
 2. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.
 3. Piping above roof to be supported with freestanding roof pipe supports unless detailed otherwise. At roofing applications, the adhesion mastic is to be specifically submitted to and approved by the roofing system manufacturer/installer to maintain the integrity of all warranties.
 4. At concrete floors, install a polyurethane mastic to the support block and adhere in place.
- C. Vertical Piping:
1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
 2. Riser clamps to be directly under fitting or welded to pipe. Provide neoprene pads for all systems except natural gas.

3. Riser to be supported at each floor penetration.
 4. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.
- D. Adjusting and Painting:
1. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.
 2. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

3.3 WALL AND FLOOR SLEEVES

- A. "Link-Seal" Pipe Sleeves: Install at slab on grade floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations (except for DWV piping at slab on grade). Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.
- B. Fabricated Pipe Sleeves:
1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirement, and by waterproofing requirements.
 2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
 3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
 4. Seal each end airtight with a resilient nonhardening sealer, UL listed and fire rated per ASTM 814.

3.4 BUILDING ATTACHMENTS

- A. Install within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping.
- B. Attachment to Wood Structure: Provide MSS Type 34 for attachment to wooden beam or approved attachment for a wood structure.
- C. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.
- E. Install powder-actuated drive pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Test powder-actuated insert attachments with a minimum load of 100 pounds.
- F. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.
- G. Anchor Bolts:

1. Install anchor bolts for mechanical equipment and piping as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment and piping are hung.
 2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.
- H. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.
- I. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor wall, and through equipment room walls and floors.
- J. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
1. Install fabricated pipe sleeve.
 2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
 3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814 sealant.
- K. Piping Penetrations Through Fire-rated (1 to 3 hour) Assemblies:
1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
 2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814. Use HOLDRITE HydroFlame or approved equivalent.
- L. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

3.5 FLASHING

- A. Flash and counter flash where piping passes through weather or waterproofed walls, floors and roofs.
- B. Flash vent soil pipes with flashings per Division 01, General Requirements.
- C. Flash floor drains over finished areas and roof drains, 10-inches clear on sides, minimum 36-inches x 36-inches sheet size. See Division 01, General Requirements. Fasten flashing to drain with clamping device.
- D. Install built up fixtures (mop sinks, shower stalls, shower floors) with water sealing systems/membranes to meet Code and as prescribed by Division 01, General Requirements and Section 22 00 00, Plumbing Basic Requirements. Meet all Code testing requirements. Provide drainage devices with appropriate flanges, clamps, etc. to meet these installation requirements and ensure a water-tight installation.

3.6 MISCELLANEOUS METAL AND MATERIALS

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and

miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

- B. **Fastening to In-Place Construction:** Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.
- C. **Cutting, Fitting and Placement:** Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.
- D. **Field Welding:** Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- E. **Setting Loose Plates:** Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
 - 1. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
- F. **Fabrication:**
 - 1. **General:** Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates and similar devices. Hot dip galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
 - 2. **Finishes:**
 - a. **Ferrous Metal:** After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas with primer of same material before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.

- b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials:
 - 1) Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
 - c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.
- G. Metal Fabrication:
 - 1. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
 - 2. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
 - 3. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of weld and methods used in correcting welding work, and with the following:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
 - 4. Provide hot dipped galvanized components for items exposed to weather.

END OF SECTION

SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Heat Trace Cable (Freeze Protection)

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.
 - 1. Section 22 07 00 - Plumbing Insulation
 - 2. Section 26 00 00 - Electrical Basic Requirements

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. UL 718K Pipe Heating Cable.
 - 2. CSA Design 3A, 3B, 3C.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Project Record Documents: Record physical locations of thermostats.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Provide minimum heat tracing capacities per linear foot as scheduled on Drawings.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Heat Trace Cable (Freeze Protection):
 - 1. FLX by Thermon
 - 2. SRF by Chomalox
 - 3. XL-Trace by Raychem
 - 4. CLT by Nelson
 - 5. Or approved equivalent.

2.2 HEAT TRACE CABLE (FREEZE PROTECTION)

- A. General: Provide complete UL listed system of heating cables and components listed specifically for maintaining pipe temperature over entire piping system exposed to freezing temperatures.
- B. Materials
 - 1. Cable: Self-regulating flat, flexible, low-heat density, parallel electric heater strip consisting of 2 stranded circuit conductors enclosed in semi-conductive, polymer core insulated with plastic jacket protected with tinned-copper braid. Ability to overlapped without creating hot spots and is suitable for application on plastic, copper or steel pipe.
 - 2. Voltage: See electrical drawings. Provide power connections, end seals, splices tap-offs and tees for a complete system.
 - 3. Controls: Thermostat with fixed setpoint of 40 degrees F, remote bulb and capillary sensor enclosed in a NEMA 4 enclosure.
- C. Minimum Exposure Temperature: 150 degrees F continuous.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. General: Installation to be by Division 26, Electrical.

3.2 HEAT TRACE CABLE (FREEZE PROTECTION)

- A. Location: Furnish heat trace and components for piping exposed to freezing conditions.
- B. Install cable parallel to pipe or spiral wrap to achieve power density per linear foot of pipe to prevent freezing.
- C. Heat Trace and Components are to be installed per the following:
 - 1. Attach heat trace cable to pipe with polyester tape; increments not exceeding 1-foot.
 - 2. Install thermostat capillary and bulb to pipe with polyester tape assuring a firm bulb contact with pipe. Install bulb without contact to heat cable. Maximum 12-inch spacing between tape.
 - 3. Install thermostat at accessible location adjacent to pipe with minimum of exposed capillary.
 - 4. Labeling: Provide "Electric Traced" label to outside of the pipes thermal insulation on alternating sides. Locate labels at intervals of 5 to 15-feet over entire length of heat tracing.
 - 5. Coordinate installation with work under Division 26, Electrical for electrical service to each thermostat.
 - 6. Coordinate application of heat tape with pipe insulation and weather jacketing.

END OF SECTION

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Plastic Nameplates
 - 2. Tags
 - 3. Plastic Pipe Markers

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, submit Valve Schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals. Provide schedules organized as follows:
 - 1. Equipment Type:
 - a. Identification:
 - b. Background:
 - 1) Size:
 - 2) Color:
 - c. Lettering:
 - 1) Size:
 - 2) Color:

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
 - 2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 22, Plumbing Sections. Where more than a single type is specified for application, provide single selection for each product category.
- B. Plastic Nameplates:
 - 1. Brady Corporation
 - 2. Or approved equivalent.
- C. Tags:
 - 1. Brady Corporation
 - 2. Brimer
 - 3. Champion America Inc.
 - 4. Craftmark
 - 5. Seton Identification Products
 - 6. Or approved equivalent.
- D. Plastic Pipe Markers:
 - 1. Brady Corporation
 - 2. Brimer
 - 3. Champion America Inc.
 - 4. Craftmark
 - 5. Seton Identification Products
 - 6. Or approved equivalent.

2.2 PLASTIC NAMEPLATES

- A. Description: Engraving stock melamine plastic laminate 1/8-inch thick, engraved with engraver's standard letter style of the sizes and wording indicated.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/2 inch.
 - 3. Background Color: Black.
 - 4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
 - 5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.
 - 6. Signage for hot water outlets on 140 degree F hot water systems not protected by ASSE 1070 mixing valves; hose bibbs, janitor sinks, and fixtures used by trained personnel.
 - a. Manufacturer's standard 1/8-inch thick engraved plastic laminate signage 4 by 4-inches.
 - b. Letter Color: Red.
 - c. Letter Height: 1/2 inch.
 - d. Background Color: White.
 - e. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.3 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2-inch diameter.
- B. Metal Tags: Polished Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.
- C. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.
- D. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
- E. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
- F. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7-inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 - 4. Color: Yellow background with black lettering.

2.4 PLASTIC PIPE MARKERS

- A. Color: Conform to ASME A13.1 and ANSI Z535.1.
- B. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Lettering and Graphics:
 - 1. General: Coordinate names, abbreviations and other designations used in plumbing identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.
 - 2. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).
- B. Preparation: Degrease and clean surfaces to receive adhesive for identification materials.

- C. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- D. Install valve schedule at each mechanical room.
- E. Access Doors: Provide markers on each access door and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions.

3.2 PLASTIC NAMEPLATES

- A. Identify pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates riveted to equipment body.
- B. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners.

3.3 TAGS

- A. Small devices, such as in-line pumps, may be identified with tags. Use metal tags on piping 3/4-inch diameter and smaller.
- B. Identify valves in main and branch piping with metal tags. Indicate valve function and the normally open or closed positions on the valve tag.
- C. Coordinate with the facility maintenance personnel to ensure consistency with the existing tagging system.
- D. Tag balancing valves with balanced GPM or CFM indicated after balancing is completed and accepted.
- E. Install tags with corrosion resistant chain.

3.4 PLASTIC PIPE MARKERS

- A. Install plastic pipe markers in accordance with manufacturer's instructions.
- B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- C. For exterior underground piping installations, install underground plastic pipe markers with tracer wire 6 to 8-inches below finished grade directly above buried pipe.
- D. Identify piping, concealed or exposed, with plastic tape 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 (reduced to 10-feet in congested areas and mechanical equipment rooms) 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. Locate near branches, valves, control devices, equipment connections, access doors, floor/wall penetrations.

END OF SECTION

SECTION 220593 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:

1. Balancing water flow within distribution systems of all Division 22, Plumbing Sections, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting plumbing systems to provide indicated quantities.
3. Verifying that automatic control devices are functioning properly.
4. Reporting results of the activities and procedures specified in this Section.

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Acceptable Balance Firm:

a. General:

- 1) Procure services of independent Testing, Adjusting, and Balancing (TAB) agency to balance, adjust and test water circulating. Minimum Experience: 5 years.

b. Industry Standards: Testing and Balancing will conform to NEBB, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and American National Standards Institute (ANSI) as follows:

- 1) NEBB: Comply with Procedural Standards for Testing, Adjusting Balancing of Environmental Systems.
- 2) ASHRAE: Comply with recommendations pertaining to measurements, instruments, and TAB.

c. Test Observation: If requested, conduct tests in the presence of the Architect or the Architect's representative.

2. Provide proof of testing agency having successfully completed at least five projects of similar size and scope.
3. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
4. Owner Witness: Perform tests in the presence of the Owners representative.

5. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
6. Simultaneous Testing: Test observations by the Authority Having Jurisdiction (AHJ), the Owner's Authorized Representative and the engineer's representative need not occur simultaneously.
7. Do not perform TAB work until plumbing equipment has been completely installed and is operating continuously as required.
8. Conduct TAB with clean filters in place. Clean strainers prior to performing TAB.
9. Agent Qualifications: Engage a TAB Agent certified by AABC or NEBB.
10. TAB Conference: Meet with the Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.
 - a. Agenda Items: Include at least the following:
 - 1) Submittal distribution requirements.
 - 2) TAB plan.
 - 3) Work schedule and Project site access requirements.
 - 4) Coordination and cooperation of trades and subcontractors.
 - 5) Coordination of documentation and communication flow.
11. Certification of TAB Reports: Certify the TAB field data reports. This certification includes the following:
 - a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
12. TAB Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
13. TAB Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
14. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
15. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
16. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.7 DEFINITIONS

- A. Adjust: To regulate fluid flow rate at the equipment.
- B. Balance: To proportion flows within the distribution system, including sub mains, branches, and terminals, according to design quantities.

- C. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- D. Report Forms: Test data sheets for recording test data in logical order.
- E. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- F. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- G. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- H. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- I. TAB: Testing, Adjusting, and Balancing.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.
- M. AABC: Associated Air Balance Council.
- N. AMCA: Air Movement and Control Association.
- O. CTI: Cooling Tower Institute.
- P. NEBB: National Environmental Balancing Bureau.
- Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.8 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, controls installers, and other mechanics to operate systems and equipment to support and assist TAB activities.
- B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on piping distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PROJECT CONDITIONS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire TAB period. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.
- B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.

- C. Non-Owner Occupancy: Complete balancing of building systems prior to Substantial Completion and owner occupancy.

3.2 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of Plumbing systems and equipment.
- C. Examine equipment performance data including pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- G. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.
- H. Examine equipment for installation and for properly operating safety interlocks and controls.
- I. Examine automatic temperature system components to verify the following:
 - 1. Valves, and other controlled devices operate by the intended controller.
 - 2. Valves are in the position indicated by the controller.
 - 3. Integrity of valves for free and full operation and for tightness of fully closed and fully open positions.
 - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
 - 5. Sensors are located to sense only the intended conditions.
 - 6. Sequence of operation for control modes is according to the Contract Documents.
 - 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
- J. Report deficiencies discovered before and during performance of TAB procedures.
- K. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.

- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Isolating and balancing valves are open and control valves are operational.
- C. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - 1. Attendance is required by installers whose work will be tested, adjusted, or balanced.
- D. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.

3.4 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform TAB procedures on each system according to the procedures contained in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation for pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment settings with paint or other suitable, permanent identification material, including control positions, valve indicators and similar controls and devices, to show final settings.

3.5 ADJUSTMENT TOLERANCES

- A. Piping Systems: Adjust to within plus or minus 10 percent of design.

3.6 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings locations where other critical measurements were taken and cross reference location in final report.

3.7 FUNDAMENTAL PROCEDURES FOR PIPING SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 10 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare systems for TAB according to the following, in addition to the general preparation procedures specified above:

1. Open manual valves for maximum flow.
2. Check expansion tank liquid level, or air charge if bladder type.
3. Check makeup-water-station pressure gauge for adequate pressure.
4. Check flow-control valves for specified sequence of operation and set at design flow.
5. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.8 FINAL REPORT

- A. General: Computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into Sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.
 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
 1. Pump curves.
 2. Field test reports prepared by system and equipment installers.
 3. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 1. Title page.
 2. Name and address of TAB Agent.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB Agent who certifies the report.
 10. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 11. Nomenclature sheets for each item of equipment.
 12. Notes to explain why certain final data in the body of reports vary from design values.
- E. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.
 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm (L/s).
 - g. Water pressure differential in feet of head or PSIG (kPa).
 - h. Required net positive suction head in feet of head or PSIG (kPa).

- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.

END OF SECTION

SECTION 220700 - PLUMBING INSULATION**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Type 1, Glass Wool Pipe Insulation
 - 2. Type 2, Flexible Elastomeric Insulation
 - 3. Type 5, Glass Wool Equipment Insulation
 - 4. Type 7, ADA Accessible Lavatory/Sink Insulation Kit
 - 5. Accessories
 - 6. Pipe Fitting Insulation Covers

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. 22 05 33, Heat Tracing for Plumbing Piping

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Piping insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Installer qualifications.
 - 2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
 - 3. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
 - 4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
 - 5. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.
- B. In addition, meet the following:
 - 1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.

2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
4. Installer to have minimum 5 years' experience in the business of installing insulation.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.7 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with requirements of current edition of UL "Pipe and Equipment Coverings".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Type 1, Glass Wool Pipe Insulation:
 1. Owens-Corning
 2. Johns Manville
 3. Or approved equivalent.
- B. Type 2, Flexible Elastomeric Insulation:
 1. Insulation:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
 2. Glue:
 - a. Armacell LLC Armaflex Low VOC Adhesive
 - b. K-Flex
 - c. Or approved equivalent.
 3. Paint:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
- C. Type 5, Glass Wool Equipment Insulation:
 1. Knauf
 2. Owens-Corning
 3. Johns Manville
 4. Or approved equivalent.
- D. Type 7, ADA Accessible Lavatory/Sink Insulation Kit:
 1. IPS/Truebro
 2. McGuire/Pro-Wrap
 3. Plumberex/Pro-Extreme

4. Brocar Trap Wrap
 5. Or approved equivalent.
- E. Accessories:
1. ITW Insulation Systems
 2. Or approved equivalent.
- F. Pipe Fitting Insulation Covers:
1. Zeston Johns Manville
 2. ITW Insulation Systems
 3. Or approved equivalent.
- 2.2 TYPE 1, GLASS WOOL PIPE INSULATION
- A. Glass Fiber: ASTM C547 Type I and IV; rigid molded, noncombustible.
1. Thermal Conductivity Value: 0.27 BTU*in/(hr*sf*F) at 75 degrees F.
 2. Maximum Service Temperature: 850 degrees F to 1000 degrees F.
 3. Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, with self-sealing longitudinal laps and butt strips or vapor barrier mastic.
- 2.3 TYPE 2, FLEXIBLE ELASTOMERIC INSULATION
- A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
1. Thermal Conductivity Value: 0.25 BTU*in/(hr*sf*F) at 75 degrees F.
 2. Maximum Service Temperature of 220 degrees F.
 3. Maximum Flame Spread: 25.
 4. Maximum Smoke Developed: 50 (3/4-inch thick and below).
 5. Connection: Waterproof vapor retarder adhesive as needed.
 6. UV Protection: UV outdoor protective coating per manufacturer's requirements.
- B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.
- C. Paint: Nonhardening high elasticity type, specifically manufactured as a protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.
- 2.4 TYPE 5, GLASS WOOL EQUIPMENT INSULATION
- A. Flexible Glass Wool Blanket: ASTM C612; flexible.
1. Thermal Conductivity Value: 0.24 BTU*in/(hr*sf*F) at 75 degrees F.
 2. Maximum Service Temperature: 450 degrees F.
- 2.5 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT
- A. P-traps, trap arms, tail pieces, hot water and cold water insulating guards meeting ASTM C1822. Molded closed cell insulation with vinyl cover and nylon fasteners, paintable. Provide accessories as required for complete installation covering all exposed waste piping, water piping, stops and supplies. Color white.
- 2.6 ACCESSORIES
- A. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- B. Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories,

i.e., adhesives, mastics, cements and tape to have same flame and smoke component ratings as insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.7 PIPE FITTING INSULATION COVERS

- A. PVC Plastic Fitting Covers: Schuller Zeston 2000, Knauf Proto Fitting or approved equivalent. One-piece molded type fitting covers and jacketing material, gloss white. Connections: Tacks; pressure sensitive color matching vinyl tape.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION INFORMATION

- A. Verification of Conditions:
 - 1. Do not apply insulation until pressure testing and inspection of piping has been completed.
 - 2. Examine areas and conditions under which insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Preparation: Clean and dry surfaces to be insulated.
- C. Installation:
 - 1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.
 - 2. Piping and Equipment:
 - a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
- D. Provide accessories as required. See Part 2 Article "Accessories" above.
- E. Protection and Replacement: Protect installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- F. Labeling and Marking: Provide labels, arrows and color coding on piping. Attach labels and flow direction arrows to jacketing per Section 22 05 53, Identification for Plumbing Piping and Equipment.
- G. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 1-1/2-inches and larger (hot and cold piping).
- H. Piping Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Pipe Size	Insulation Thickness
Hot Water Piping Above Grade (105F to 140F)	1	Runouts =<1-1/4-inch (uncirculated branches located in partitions within conditioned spaces)	1-inch
		Mains =<1-1/4-inch	1-inch
		Mains >1-1/4-inch	1-1/2-inch
Hot Water Circulation Piping Above Grade (105F to 140F)	1	Mains =<1-1/4-inch	1-inch
		Mains >1-1/4-inch	1-1/2-inch
Cold Water Piping Above Grade	1	=<1-1/2-inch	1/2-inch
		>1-1/2-inch	1-inch
Water Piping Exposed to Weather	1, 2	All	1-1/2-inch
Piping with Heat Tracing	1, 2	Same as circulated hot water based on pipe size and service temperature.	
ADA Accessible Lavatory/Sink	7	All	As Listed
Storage Tanks	5	All	2-inch
Condensate Drain Piping	1, 2	All	1/2-inch

3.2 TYPE 1, GLASS WOOL PIPE INSULATION

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions for below grade installation.
- C. Lap seal insulation with waterproof adhesive. Do not use staples or other methods of attachment which would penetrate vapor barrier. Apply fitting covers with seated tacks and vapor barrier tape.
- D. Apply insulation to pipe and seal with self-sealing lap. Use self-sealing butt strips to seal butt joints. Insulate fittings, valves and unions with single or multiple layers of insulation and cover to match pipe or use preformed PVC molded insulation covers.
- E. Above Grade Roof Drain/Overflow Drain Piping: Cover all roof drain piping and overflow drain piping with sectional pipe covering.

3.3 TYPE 2, FLEXIBLE ELASTOMERIC INSULATION

- A. See General Installation Requirements above.
- B. Install in accordance with manufacturer's instructions for below grade installation.

- C. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.
 - D. Flexible Elastomeric Tubing: Slip insulation over piping or if piping is already installed, it should be slit and snapped over piping. Joints and butt ends must be adhered with 520 adhesive.
- 3.4 TYPE 5, GLASS WOOL EQUIPMENT INSULATION
- A. See General Installation Requirements above.
 - B. Storage Tanks: Cover with glass wool, 2-inches thick. Finish with canvas jacket and adhesive. Overlap joints minimum of 4-inches. Apply two coats latex paint; color selected by Architect.
- 3.5 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT
- A. See General Installation Requirements above.
 - B. Install in accordance with manufacturer's instructions.
 - C. Provide lavatory/sink insulation kit. Install on waste fittings, hot and cold water stops and supplies.
- 3.6 ACCESSORIES
- A. See General Installation Requirements above.
 - B. Install in accordance with manufacturer's instructions.
 - C. Furnish and install accessories for all insulation types listed in this Section.
- 3.7 PIPE FITTING INSULATION COVERS
- A. See General Installation Requirements above.
 - B. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 221000 - PLUMBING PIPING**PART 1 - GENERAL****1.1 SUMMARY****A. Work Included:**

1. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Buried Within 5-feet of Building
2. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Above Grade
3. Water Piping, Buried Within 5-feet of Building
4. Hot and Cold Domestic Water Above Grade
5. Condensate Piping
6. Cleanouts

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
1. NSF 61, Annex G.
 2. Steel pipe to conform to ASTM and ANSI Standards as specified in this Section.
 3. Copper piping to conform to ASTM B88, B306 and B208 and the standards of Copper Development Association (CDA), and American Welding Society, (AWS).
 4. Cast Iron Piping to conform to standards of ASTM A-74, CISPI 301 and FM 1680.
 5. Manufacturer's Standards Society (MSS) for valving and support reference standard.
 6. American Water Works Association (AWWA) for Valving Assembly Standards.
 7. American Society of Sanitation Engineers (ASSE) for Valving Standards.
 8. American National Standards Institute (ANSI) for Piping Standards.
 9. NFPA Standard 51B - "Fire Prevention in Use of Cutting and Welding Processes".
 10. Crosslinked polyethylene (PEX) pipe conforming to ASTM F876, F877 and CSA B1375, or DIN 16892 and 16893.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. See component manufacturers listed in individual articles below.
- B. AB&I
- C. American-USA
- D. Cerro
- E. Charlotte
- F. Clamp-All
- G. Conbraco/Apollo Press
- H. Elkhart
- I. Enfield
- J. Gruvlok
- K. Husky
- L. Ideal
- M. Mission
- N. Mueller
- O. Nibco
- P. Shurjoint Mechanical Couplings
- Q. Sioux Chief
- R. Spears
- S. Tyler
- T. Viega
- U. Zurn
- V. Or approved equivalent.
- W. Cleanouts:
 - 1. J.R. Smith
 - 2. Mifab
 - 3. Sioux Chief
 - 4. Wade
 - 5. Watts
 - 6. Zurn
 - 7. Or approved equivalent.
- X. Firestopping Penetrations in Fire Rated Wall Floor Assemblies:
 - 1. Hilti
 - 2. Proset
 - 3. Or approved equivalent.

2.2 GENERAL

- A. Provide pipe, tube and fittings of the same type, fitting requirements, grade, class and the size and weight indicated or required for each service, as indicated in other Division 22, Plumbing

Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.

- B. Manufactured materials delivered, new to the project site and stored in their original containers.
 - C. Product Marking: Furnish each item with legible markings indicating name brand and manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.
- 2.3 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5-FEET OF BUILDING
- A. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.
 - 1. Fittings: Cast iron.
 - 2. Coupling Assembly:
 - a. Heavy Duty: ASTM C1540, Clamp-All Hi-Torq 125, Husky SD 4000, Mission HeavyWeight couplings.
 - b. Mechanical joint coupling for hubless pipe and fittings is to consist of an elastomeric sealing sleeve and a metallic shield that comply with CISPI 310, ASTM C or ASTM C 1540. The elastomeric sealing sleeve is to conform to ASTM C564 or CSA B602 and is to be provided with a center stop. Mechanical joint couplings are to be installed in accordance with the manufacturer's instructions.
 - B. PVC Pipe: ASTM D 2665 IPS Schedule 40, **SOLID WALL** piping for drainage/waste and vent (DWV).
 - 1. Fittings: PVC DWV ASTM D2665.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement, 2-step glue (primer and glue) is required.
- 2.4 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE
- A. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.
 - 1. Fittings: Cast iron.
 - 2. Coupling Assembly:
 - a. Heavy Duty: ASTM C1540, Clamp-All Hi-Torq 125, Husky SD 4000, Mission HeavyWeight couplings.
 - b. Standard Duty: ASTM C1277 or CISPI 310.
 - B. Copper Tube: ASTM B 306, DWV
 - 1. Fittings: ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, alloy Sn50 solder.
- 2.5 WATER PIPING, BURIED WITHIN 5-FEET OF BUILDING
- A. Copper Pipe: ASTM B88, hard drawn, Type K (A).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Joints: Brazed - BCuP2.
 - B. Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: Ductile or gray iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, rubber gasket with 3/4-inch diameter rods, mega lug type.

2.6 HOT AND COLD DOMESTIC WATER ABOVE GRADE

- A. Copper Tube: 3-inches and above. ASTM B88 (ASTM BA88m), Type L (B), Drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Brazed BCuP2.
- B. Copper Tube: 2-1/2-inches and smaller. ASTM B88 (ASTM B88M), Type L (B), Drawn.
 - 1. Fittings: ASME B16.18 copper.
 - 2. Joints: ASTM B32, alloy Sn95 solder.
- C. Copper Tube: Water pressures up to 250 PSI gauge. ASTM B 88 (ASTM BA 88m), Type L (B), Drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Brazed BCuP2.
- D. Copper Tube: ASTM B88 (ASTM B88M), Type L (B) for 2-1/2-inches and smaller, Type L (B) for 3-inches and larger, Drawn.
 - 1. Fittings: Fittings are to be manufactured to copper tubing sizes, with grooves designed to accept grooved end couplings of the same manufacturer. Fittings are to be wrought copper, conforming to ASTM B75 alloy C12200 or ASTM B-152 alloy C11000 and ANSI B16.22.
 - 2. Coupling: 2-inches to 8-inches for copper tubing consisting of ductile iron cast housings meeting ASTM A536, complete with a synthetic rubber gasket of a pressure-responsive design, with plated nuts and bolts to secure unit together. Couplings to be manufactured to connect copper tubing sized tube and fittings.

2.7 CONDENSATE PIPING

- A. Copper Tube: ASTM B 88 (ASTM B898M), Type K (A), L (B), or M (C).
 - 1. Fittings: ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, alloy Sn50 solder.

2.8 CLEANOUTS

- A. Locate cleanouts as shown on Drawings and as required by local code. Cleanouts same size as pipe except that greater than 4-inches will not be required. Plastic components not allowed, except unless specifically noted.
- B. Types:
 - 1. Tile Floor Cleanouts: J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread, ABS plug and standard screws.
 - 2. Carpeted Floor Cleanout: J. R. Smith 4020-X with carpet clamping frame, round heavy-duty nickel bronze top, taper thread, ABS plug, carpet clamping device and standard screws.
 - 3. Concrete Floor Cleanout (General): J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.
 - 4. Parking, Drives and Concrete Floor Cleanouts (Heavy Load): J. R. Smith 4100 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.
 - 5. Wall Cleanout: J. R. Smith 4472-U, countersunk bronze taper thread plug, stainless steel shallow cover and vandalproof screws.
 - 6. Outside Area Walks: J. R. Smith 4020-U with round heavy-duty nickel bronze top, taper thread, ABS plug and top secured with vandalproof screws. Install in 18- by 18- by 6-inch deep concrete pad flush with grade.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Underground Piping Systems:

1. Examination: Verify that excavations are to required grade, dry, and not over-excavated.
2. Perform necessary excavation and backfill required for installation of plumbing work. Repair piping or other work at no expense to Owner.
3. Water: Keep excavations free of standing water. Re-excavate and fill back excavations damaged or softened by water or frost to original level with sand, crushed rock or other approved material at no expense to Owner.
4. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of testing laboratory.
5. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (muck, peat), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose off site native excavation material. Adequate width of trench for proper installation of piping or conduit.
6. Support Foundations:
 - a. Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to depth which is determined by Architect as appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction and disposal of excavated materials to conform to requirements contained in other Specification Sections or Drawings.
 - b. Over-Excavations: Where trench excavation exceeds required depths, provide, place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.
 - c. Foundation Material: Where native material has been removed, place and compact necessary foundation material to form base for replacement of required thickness of bedding material.

	Class A		Class B	
Material Passing	Min.	Max.	Min.	Max.
3/4-inch Square Opening	27	47	0	1

- d. Bedding Material: Full bed piping on sand, pea gravel, or 3/4-inch minus crushed rock. Place minimum 4-inch deep layer of sand, pea gravel, or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe on bedding for its entire length. Provide additional bedding in excessively wet, unstable, or solid rock trench bottom conditions as required to provide firm foundation.
7. Backfilling:
 - a. Following installation and successful completion of required tests, backfill piping in lifts.

- 1) In "Pipe Zone" place backfill material and compact in lifts not to exceed 6-inches in depth to height of 12-inches above top of pipe. Place backfill material to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.
- 2) Place and compact backfill above "Pipe Zone" in layers not to exceed 12-inches in depth.
- b. Backfill Material:
 - 1) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand or pea gravel.
 - 2) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."
8. Compaction of Trench Backfill:
 - a. Where compaction of trench backfill material is required, use one of following methods or combination thereof:
 - 1) Mechanical tamper,
 - 2) Vibratory compactor, or
 - 3) Other approved methods appropriate to conditions encountered.
 - b. Architect to have right to change methods and limits to better accommodate field conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.
- B. General Installation:
 1. Work performed by experienced journeyman plumbers. No exceptions.
 2. Provide access panels for concealed valves, shock arrestors, trap primers and the like.
 3. Install pipes and pipe fittings in accordance with recognized industry practices and manufacturer's recommendations.
 4. Align piping accurately at connections, within 3/32-inch misalignment tolerance. Comply with ANSI B31 Code for Pressure Piping.
 5. Locate piping runs, as indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2-inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view by locating it in column enclosures, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.
 - a. Do not run piping through transformer vaults, telephone, elevator, electrical or electronic equipment spaces or enclosures unless indicated on Drawings.
 - b. Concealed Piping Above Suspended Ceiling: Plan and coordinate to avoid interferences; install to maintain suspended ceiling heights shown on Architectural Drawings. Allow sufficient space above removable ceiling panels for panel removal. Locate piping so that valves are visible and accessible within 24-inches horizontally and vertically from point of access to the ceiling space. Provide plenum rated materials for ceiling spaces which are being used as plenums.

- c. Exposed Work: Run pipes parallel to the closest wall unless otherwise shown on Drawings; maintain maximum headroom; avoid light fixtures.
- d. Insulation Space Allowance: In piping work, allow space for pipe insulation and jackets. If interferences occur, move the piping to accommodate insulation thickness specified.
- e. Pipe Lengths: Do not use short lengths or nipples at locations where a full length of pipe will fit.
- f. Alignment Prior to Supporting and Anchoring: Place piping in proper alignment and position prior to connection to anchors, expansion loops, and equipment. Furnish jacking devices, temporary steel structural members, and assembled structures as necessary. Remove temporary equipment and structures supplied by contractor at completion; such items to remain Contractor property.
- g. Valve and Equipment Connections: Piping not to place undue stress on flanged valves and equipment connections. Install mating flange faces true and parallel to each other and not requiring springing of piping for assembly. Pipe hangers and supports to carry the full weight of the pipe and fluid.
- h. Piping Leaks: Correct immediately; use new materials; leak-sealing compounds or peening not permitted.
- i. Pressure Ratings of Fittings, Valves, and Devices in Piping Systems: Pressure rating to be equal to, or greater than, the maximum working pressure of the system.
- j. Equipment Vents and Drains: Provide for coils and vessels which contain water. Provide isolation valves and outlet valves at piping high and low points to permit venting and draining of the vessel without venting and draining connected piping. Provide hose connections and caps on drain lines.
- k. Escutcheon Plates: Where exposed insulated and uninsulated piping passes through walls, floors or ceilings; provide spring clip type. Provide plates on both sides of wall or floor.

C. Testing:

1. General:

- a. Provide temporary equipment for testing, including pumps, compressors, tanks, and gauges, as required. Test piping systems before insulation (if any) is installed and remove or disengage control devices before testing. Where necessary, test sections of each piping system independently, but do not use piping valves to isolate sections where test pressures exceed local valve operating pressure rating. Fill each section with water, compressed air, or nitrogen and pressurize for the indicated pressure and time.
- b. Notify Architect and local Plumbing Inspector 2 days before tests.
- c. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- d. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.

- e. Send test results to Architect for review and approval and include in Operation and Maintenance Manual.
 2. Testing of Pressurized Systems:
 - a. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
 - b. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
 3. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- D. Corrosive Soil Conditions:
1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's recommendations.
 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
 3. Obtain and review project soils report for verification of requirements concerning corrosive soils.
- E. Protection:
1. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping, ductwork, fixtures, equipment and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore to its original condition or replace fixtures, equipment or apparatus damaged prior to final acceptance of work.
- F. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- G. Cut piping squarely, free of rough edges and reamed to full bore. Insert piping fully into fittings.
- H. Provide joints of type indicated in each piping system.
- I. Thread pipe in accordance with ANSI/ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- J. Sleeves:
1. Pipe Sleeves:
 - a. Layout work in advance of pouring concrete, furnish, and set sleeves necessary to complete work.
 - b. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with non-shrinking grout or approved caulking compound (Except DWV Piping penetrating a concrete slab set on finish grade), provide "Link-Seal" sleeve sealing system for concrete/slab penetrations which are below grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements

- c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Provide modular link sealing system for concrete penetrations which are below grade. Caulk/seal piping passing through fire-rated assemblies per local AHJ requirements.
 - d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Indicate penetrations on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
2. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
 - a. Install fabricated pipe sleeve.
 - b. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification.
 - c. Seal each end airtight with a resilient nonhardening seal per code.
 3. Piping penetrations through fire-rated (1 to 3 hour) assemblies:
 - a. Select and install pre-engineered pipe penetration system in accordance with UL listing and manufacturer's recommendation.
 - b. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E84.
- 3.2 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5-FEET OF BUILDING
- A. Excavation and Backfill:
 1. See 3.01 above.
 - B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
 - C. Corrosive Soil Conditions:
 1. Wrap steel, iron, copper or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per manufacturer's requirements.
 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
 - D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.
 - E. Sanitary and Storm Drainage:
 1. Grade piping smaller than 3-inch at a uniform pitch of 2 percent.

2. Grade piping 3-inch or greater at a uniform pitch of 1 percent unless otherwise noted on Drawings.
 3. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on indirect waste or drain piping exceeding 60-inches.
 4. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures are specified in Section 22 40 00, Plumbing Fixtures.
 5. Drains:
 - a. Install drains to suit finished floor. Install drains and components per manufacturer's instructions. Slope flooring to floor drain or sink a minimum of 1/2-inch below finished floor elevation.
 - b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
 6. Wall Access Panel: Secure to wall framing and install so that flange forms a close fitting joint with the finished wall surface.
 7. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
 8. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.
- F. Epoxy Coated Cast Iron Pipe and Fittings: Coat the piping terminus of any cut piping with an applied epoxy per manufacturer's instructions. Denso Protal 7200 fast-cure epoxy repair coating.

3.3 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE

- A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- B. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
 1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- C. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.
- D. Cast-Iron Joints: Comply with coupling manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.
- E. Sanitary and Storm Drainage:

1. Grade piping smaller than 3-inch at a uniform pitch of 2 percent.
2. Grade piping 3-inch or larger at a uniform pitch of 1 percent unless otherwise noted on Drawings.
3. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on indirect waste or drain piping exceeding 60-inches.
4. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures are specified in Section 22 40 00, Plumbing Fixtures.
5. Drains:
 - a. Install drains to suit finished floor or roof surface. Install drains and components per manufacturer's instructions. Slope flooring to floor drain or sink a minimum of 1/2-inch below finished floor elevation.
 - b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
6. Wall Access Panel: Secure to wall framing and install so that flange forms a close fitting joint with the finished wall surface.
7. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
8. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.

3.4 WATER PIPING, BURIED WITHIN 5-FEET OF BUILDING

- A. Excavation and Backfill:
 1. See 3.01 above.
- B. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
- C. Domestic Water:
 1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
 2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
 3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
 4. Use unions for piping connections to equipment.
 5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.
 6. Use reducers or increasers. Use no bushings.
 7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
 8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
 9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.
 10. Make ferrous to non-ferrous connections with dielectric fittings.

11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2-inches. Use no close nipples. Use only shoulder-type nipples.
 12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
 13. Provide drain valves at base of risers and at low points on the system.
 14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.
- D. Sterilization of Domestic Water System:
1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
 2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.
 3. Certification: Provide copy of domestic water chlorination certificate in each operations and maintenance manual.
 4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.
- E. Buried Pre-Insulated Pipe Installation:
1. Installation and Testing: Install and test products in accordance with manufacturer's installation instructions.
 2. Manufacturer's installation instructions are to describe the following:
 - a. Storage and handling of pipes.
 - b. Trench preparation.
 - c. Installing pipe.
 - d. Installing accessories.
 - e. Installing fittings.
 - f. Building penetrations.
 - g. Field insulation kits.
 - h. Testing.
- ### 3.5 HOT AND COLD DOMESTIC WATER ABOVE GRADE
- A. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
- B. Testing of Pressurized Systems:
1. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
 2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
- C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- D. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- E. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.
- F. Braze copper tube and fitting socket with BCuP series filler metal without flux. Use listed brazing flux for joining of copper tube to brass or bronze fittings, meeting AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet is to be visible around the completed joint. After cooling, thoroughly remove flux residue with warm water and a brush prior to testing. Do not use BCuP filler on copper alloys containing over 10 percent nickel. Cap or plug piping during construction to prevent entry of foreign material.
- G. Domestic Water:
1. "Piping" to include pipes, fittings, nipples, valves and accessories connected thereto.
 2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
 3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
 4. Use unions for piping connections to equipment.
 5. Provide sufficient elbows, swings and offsets to permit free expansion and contraction.
 6. Use reducers or increasers. Use no bushings.
 7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
 8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
 9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.
 10. Make ferrous to non-ferrous connections with dielectric fittings.
 11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2-inches. Use no close nipples. Use only shoulder-type nipples.
 12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
 13. Provide drain valves at base of risers and at low points on the system.
 14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.
- H. Sterilization of Domestic Water System:

1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.
3. Certification: Provide copy of domestic water chlorination certificate in each operations and maintenance manual.
4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.

3.6 CONDENSATE PIPING

A. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

3.7 CLEANOUTS

- #### A.
- Install in aboveground piping and building drain piping as indicated, as required by code; at each change in direction of piping greater than 135 degrees; at minimum intervals of 100-feet; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping. Select type to match adjacent building finish. Provide shop drawings to Architect to coordinate locations and types of cleanouts with Architect prior to installation.

END OF SECTION

SECTION 223000 - PLUMBING EQUIPMENT**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Emergency Stop Pushbutton Switch
 - 2. Commercial Heavy Duty Electric Storage Type Water Heaters
 - 3. Domestic Expansion Tanks Non-ASME
 - 4. Domestic Circulation Pumps - Close-Coupled, In-Line
 - 5. Domestic Circulation Pumps - Close-Coupled, Horizontally Mounted
 - 6. Garbage Disposal

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Seismic anchor details and calculations signed and stamped by licensed Virginia structural engineer with equipment data.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NSF 61, Annex G compliant.
 - 2. ISO 9001 Certified.
 - 3. IAPMO Low Lead Certification
- C. Products approved for installation by state authorizing agency, no exceptions.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Emergency Stop Pushbutton Switch:
 - 1. Group Schneider/Square D Class 9001 XB5 Family
 - 2. Eaton
 - 3. Siemens
 - 4. General Electric

5. Or approved equivalent.
 - B. Commercial HeavyDuty Electric Storage Type Water Heaters:
 1. Hubbell Series E
 2. A.O. Smith
 3. Bradford White
 4. Bock
 5. State
 6. Rheem/Ruud
 7. Or approved equivalent.
 - C. Domestic Expansion Tanks Non-ASME:
 1. Bell and Gossett Series PT
 2. American Wheatley
 3. Amtrol
 4. Armstrong
 5. Watts
 6. Or approved equivalent.
 - D. Domestic Circulation Pumps - Close-Coupled, In-Line:
 1. Bell and Gossett Series
 2. Armstrong
 3. Grundfos
 4. Paco
 5. Taco
 6. Or approved equivalent.
 - E. Domestic Circulation Pumps - Close-Coupled, Horizontally Mounted:
 1. Bell and Gossett Series
 2. Armstrong
 3. Grundfos
 4. Paco
 5. Taco
 6. Or approved equivalent.
 - F. Garbage Disposal:
 1. In-Sink-Erator
 2. Salvajor
 3. Hobart
 4. Waste King
 5. Or approved equivalent.
- 2.2 GENERAL
- A. Reference drawings for capacities and specific model numbers.
- 2.3 EMERGENCY STOP PUSHBUTTON SWITCH
- A. Provide 30mm diameter turn-to-release red pushbutton operator with contact blocks to disconnect power to the boiler burner controls and gas service when button is pushed. Contacts are mechanically latching, such that if power is lost and then restored, it is not necessary to manually reset the button to restore gas and power to the boiler. Basis-of-Design: Group Schneider/Square D Class 9001 Family XB series.

2.4 COMMERCIAL HEAVY DUTY ELECTRIC STORAGE TYPE WATER HEATERS

- A. System: Domestic Hot Water
- B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
- C. Tank welded steel commercial construction designed for 150 PSI. Tank is to be lined with seamless Hydrastone cement to minimum thickness of 1/2-inch on 100 percent of interior tank surfaces, tank to be fabricated from solid copper-silicon and not require any type of anodic protection. Tank designed and fabricated with non-ferrous copper-silicon threaded tapings and non-ferrous inlet and outlet piping for maximum corrosion resistance. Steel tank tapings will not be acceptable. Entire tank is to be insulated with minimum of 2-inches thick polyurethane foam insulation and exceed latest ASHRAE standard for stand-by heat loss. Complete heater supplied with high impact colorized composite protective jacket which cannot rust or corrode and does not require painting.
- D. Cold water inlet 3/4-inch Female NPT (1-1/2-inch Male NPT) and include non-corrosive strata-flow diffuser which prevents incoming cold water from mixing too rapidly with hot water in tank. 3/4-inch hose connection drain is supplied. Hot water outlet 3/4-inch Male NPT (1-1/2-inch Male NPT) and includes factory installed built-in heat trap to prevent water from radiating through piping during stand-by periods. Separate 3/4-inch Female NPT tapping is to be provided for relief valve installation. An ASME rated automatic reseating combination temperature and pressure safety relief valve set at 150 PSI and 210 degrees F factory supplied.

2.5 DOMESTIC EXPANSION TANKS NON-ASME

- A. Welded steel, constructed, tested and stamped in accordance with IAPMO Standards for working pressure of 125 PSI. Support floor mounted tanks with steel legs or base. Provide single flexible diaphragm securely sealed into tank to separate air charge from system water, to maintain design expansion capacity. Provide pressure gauge and air-charging fitting, and drain fitting. Diaphragm: Removable and replaceable in line.

2.6 DOMESTIC CIRCULATION PUMPS - CLOSE-COUPLED, IN-LINE

- A. System: Domestic water
- B. Description: Factory-assembled and tested, single-stage, close-coupled, in-line, seal-less centrifugal pump.
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
 - 2. Casing: Bronze/stainless steel, with threaded companion-flange connections.
 - 3. Impeller: Corrosion-resistant material.
 - 4. Motor: Non-overloading at any point on pump curve, Single speed, unless otherwise indicated. Comply with requirements in Division 22 Section "Common Motor Requirements."
- C. Capacities and Characteristics as per Drawings.
- D. See detail on Drawings for pump controls.

2.7 DOMESTIC CIRCULATION PUMPS - CLOSE-COUPLED, HORIZONTALLY MOUNTED

- A. System: Domestic water

- B. Description: Factory-assembled and -tested, overhung impeller, single-stage, close-coupled, horizontally mounted, in-line centrifugal pumps and designed for installation with pump and motor shafts mounted horizontally.
1. Pump Construction: All bronze/stainless steel.
 - a. Casing: Radially split, cast iron, with threaded companion-flange connections for pumps.
 - b. Impeller: ASTM B 584, cast bronze or stainless steel; statically and dynamically balanced, closed, and keyed to shaft.
 - c. Shaft and Shaft Sleeve: Steel shaft.
 - d. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
 - e. Bearings: Oil-lubricated; bronze-journal or ball type.
 2. Shaft Coupling: Rigid type if pump is provided with coupling.
 3. Motor: Non-overloading at any point on pump curve, Single speed, with grease-lubricated ball bearings. Comply with requirements in Division 22 Section "Common Motor Requirements."
- C. Capacities and Characteristics as per Drawings.
- D. See detail on Drawings for pump controls.

2.8 GARBAGE DISPOSAL

- A. Residential Duty:
1. General: Complete food waste disposal to include a stainless steel sink flange adapter assembly to match fixture. Dishwasher connection. Stainless steel or galvanized grind chamber, shredder ring, and two 360 degree swivel impellers/lugs. Continuous feed.
 2. Single phase, permanently lubricated motor with manual reset, corrosion protection shield, and sound absorbing upper shell. UL listed.
 3. Warranty: 2 year parts and in-home service.
- B. Commercial Light Duty:
1. General: Complete food waste disposal to include a stainless steel sink flange adapter assembly to match fixture. Stainless steel grind chamber, shredder ring, and two 360° swivel impellers. Continuous feed, automatic
 2. Stainless steel grind chamber, shredder ring, and two 360° swivel impellers. Continuous feed, automatic.
 3. Reversing split-phase motor, corrosion protection shield, and sound absorbing upper shell. UL listed.
 4. Warranty: Commercial 1 year parts and service.
- C. Commercial Heavy Duty:
1. General: Complete food waste disposal to include a stainless steel sink flange adapter assembly to match fixture. Stainless steel grind chamber, shredder ring, and two 360° swivel impellers. Continuous feed, automatic.
 2. Reversing split-phase motor, corrosion protection shield, and sound absorbing upper shell. UL listed.
 3. Controller: Stainless steel, NEMA 4, auto-reversing with automatic drop out (in case of power loss). Disconnect switch, post water flush, timed or continuous run
 4. Warranty: commercial 1 year parts and service.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- C. Orients so controls and devices needing service and maintenance have adequate access.
- D. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
- E. Connect water piping to units with shutoff valves and unions.
- F. Equipment Rigging: Heavy duty rigging eye bolts for Crosby Group swivel hoist rings installed over pump access covers for removal or maintenance.
- G. Equipment Start-Up:
 - 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
 - 2. Start-up performed by authorized manufacturer's representative or agent. Provide credentials of start-up personnel to Architect and Owner's Authorized Representative for approval.
 - 3. Remove and replace filters when start-up testing is executed.
 - 4. Manufacturer adjusts operating parameters of equipment to compensate to elevation of 500-feet above sea level.
 - 5. Architect, Commissioning Agent, and Owner's Authorized Representative will be notified 10 days prior to start-up and will be present at start-ups.
 - 6. Provide written report from manufacturer's representative on results of start-up within 48 hours.
 - 7. Technical Training of maintenance staff includes two hours minimum per each piece of equipment.
 - 8. Seismic Verification:
 - a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
 - b. Contractor's Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

3.2 EMERGENCY STOP PUSHBUTTON SWITCH

- A. Boiler/Water Heater/Gas Shutdown:
 - 1. Provide CSD.1 compliant controls.
 - 2. Remote switch: Install shutdown switch to disconnect power to the boiler burner controls and gas service in room. Install pushbutton under clear, impact-resistant flip lid. Provide red phenol label "Emergency Shutdown" locate label above pushbutton. Pushbutton to be mounted by latch side of each boiler/mechanical room door within interior of the room, unless otherwise directed by AHJ. Provide electrical wiring and raceway as necessary for installation. Provide additional relays and wiring to cut power to gas solenoid valves in the room not integral to boilers. Reference drawings for gas solenoid valve locations.

- 3.3 COMMERCIAL HEAVY DUTY ELECTRIC STORAGE TYPE WATER HEATERS
- A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
 - B. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
 - C. Orients so controls and devices needing service and maintenance have adequate access.
 - D. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
 - E. Connect water piping to units with shutoff valves and unions.
- 3.4 DOMESTIC EXPANSION TANKS NON-ASME
- A. Precharge tank per manufacturers recommendation.
 - B. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
 - C. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
 - D. Orients so controls and devices needing service and maintenance have adequate access.
 - E. Certificates: Submit appropriate Certificates of Shop Inspection and Data Report as required by provisions of ASME Boiler and Pressure Vessel Code.
 - F. Connect water piping to units with shutoff valves and unions.
- 3.5 DOMESTIC CIRCULATION PUMPS - CLOSE-COUPLED, IN-LINE
- A. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
 - B. Orients so controls and devices needing service and maintenance have adequate access.
 - C. Connect water piping to units with shutoff valves and unions.
 - D. Provide lift check valves 5 diameters downstream of pump discharge for circulating pumps piped in a parallel configuration.
 - E. Equipment Start-Up:
 - 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
 - 2. Architect, Commissioning Agent, and Owner's Authorized Representative will be notified 10 days prior to start-up and will be present at start-ups.
 - 3. Seismic Verification:
 - a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
 - b. Contractor's Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

3.6 DOMESTIC CIRCULATION PUMPS - CLOSE-COUPLED, HORIZONTALLY MOUNTED

- A. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Orients so controls and devices needing service and maintenance have adequate access.
- C. Connect water piping to units with shutoff valves and unions.
- D. Provide lift check valves 5 diameters downstream of pump discharge for circulating pumps piped in a parallel configuration.
- E. Equipment Start-Up:
 - 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
 - 2. Architect, Commissioning Agent, and Owner's Authorized Representative will be notified 10 days prior to start-up and will be present at start-ups.
 - 3. Seismic Verification:
 - a. Contractor will retain structural engineer who will submit stamped and signed anchoring and restraint details on plumbing equipment with submittal data in accordance with Division 22, Plumbing requirements.
 - b. Contractor's Structural Engineer will test and verify in writing that seismic restraints have been installed in accordance with their details.

3.7 GARBAGE DISPOSAL

- A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Install complete food waste disposal system including water, waste connections, and electrical connection, including associated control devices. Install equipment in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Set devices and adjust any support or mounting assemblies per manufacturer's recommendations.
- C. Water supplies, as applicable are to be provided with shut-off valves, solenoid valves, backflow preventers and water hammer arrestors.
- D. Coordinate power requirements and connection methods with Division 26.
- E. Equipment Start-Up:
 - 1. Start-up, test, and adjust equipment in accordance with manufacturer's start-up instructions. Check and calibrate controls.
 - 2. Start-up performed by authorized manufacturer's representative or agent. Provide credentials of start-up personnel to Architect and Owner's Authorized Representative for approval.

END OF SECTION

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General Plumbing Fixtures:
 - a. China Fixtures, White Only
 - b. Enameled Steel Fixtures, White Only
 - c. Faucet Fittings
 - d. Group Wash Fountain
 - e. Shower Valves
 - f. Stainless Steel Fixtures
 - g. Wash Fountains
 - 2. Carriers
 - 3. Electric Water Coolers
 - 4. Emergency Showers/Eyewash
 - 5. Fixture Trim
 - 6. Floor and Area Drains
 - 7. Floor Sinks
 - 8. Flushometers - Water Closet/Urinal
 - 9. Hose Bibbs
 - 10. Water Closet Seats
 - 11. Drain Boxes
 - 12. Water Supply Boxes

1.2 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Comply with lead free (less than or equal to 0.25 percent) products in drinking water systems.
 - 2. NSF 61, Annex G, Drinking Water System Components, Compliant.
 - 3. ISO 9001, Quality Management Standard Certified.
 - 4. IAPMO Low Lead Certification.

5. Provide fixtures, faucets and accessories to meet barrier free requirements of the governing code with respect to plumbing fixtures provided for the physically handicapped.
6. Items approved for use by State of Virginia.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. "Or approved equivalent" as defined in 22 00 00, Plumbing Basic Requirements. Substitution process requirements apply to approved equivalent products.
- B. General Plumbing Fixtures: See Schedule on Drawings for type.
 1. China Fixtures - White Only:
 - a. American Standard
 - b. Kohler
 - c. Or approved equivalent.
 2. Enameled Steel Fixtures - White Only:
 - a. American Standard
 - b. Kohler
 - c. Or approved equivalent.
 3. Faucet Fittings:
 - a. Public:
 - 1) American Standard
 - 2)
 - 3) Chicago
 - 4) Delta Commercial
 - 5) Moen Commercial
 - 6) Sloan
 - 7) Symmons
 - 8) T & S Brass
 - 9) Or approved equivalent.
 4. Group Wash Fountain:
 - a. Acorn
 - b. Bradley
 - c. Metcraft
 - d. Or approved equivalent.
 5. Shower Valves:
 - a. Acorn
 - b. Chicago
 - c. Delta
 - d. Moen
 - e. Powers
 - f. Symmons
 - g. Or approved equivalent.

6. Stainless Steel Fixtures:
 - a. Elkay
 - b. Haws
 - c. Just
 - d. Or approved equivalent.
7. Wash Fountains:
 - a. Acorn
 - b. Bradley
 - c. Or approved equivalent.
- C. Carriers:
 1. JR Smith
 2. Zurn
 3. Or approved equivalent.
- D. Electric Water Coolers:
 1. Elkay
 2. Halsey-Taylor
 3. Haws
 4. Oasis
 5. Sunroc
 6. Or approved equivalent.
- E. Emergency Showers/Eyewash:
 1. Bradley
 2. Encon
 3. Guardian
 4. Haws
 5. Speakman
 6. Or approved equivalent.
- F. Fixture Trim:
 1. McGuire
 2. Dearborn Brass
 3. Oatey
 4. Or approved equivalent.
- G. Floor and Area Drains:
 1. Mifab
 2. Sioux Chief
 3. Smith
 4. Wade
 5. Watts
 6. Zurn
- H. Floor Sinks:
 1. Commercial Enameling
 2. Mifab
 3. Sioux Chief
 4. Smith
 5. Wade

6. Watts
 7. Zurn
 8. Or approved equivalent.
- I. Flushometers - Water Closet/Urinal:
 1. Delaney
 2. Sloan
 3. Zurn
 4. Or approved equivalent.
 - J. Hose Bibbs:
 1. Chicago
 2. JR Smith
 3. Mifab
 4. Wade
 5. Woodford
 6. Zurn
 7. Or approved equivalent.
 - K. Water Closet Seats:
 1. Bemis
 2. Or approved equivalent.
 - L. Drain Boxes:
 1. Sioux Chief
 2. Or approved equivalent.
 - M. Water Supply Boxes:
 1. Sioux Chief
 2. Or approved equivalent.
- 2.2 GENERAL PLUMBING FIXTURES
- A. Review substitution request requirements in Division 01, General Requirements and 22 00 00, Plumbing General Requirements.
 - B. Reference Architectural Details for mounting height and location of fixtures.
 - C. Provide factory fabricated fixtures of type, style and material indicated on the plumbing fixture connection schedule shown on the Drawings. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by manufacturer, or required for complete installation. Where more than one type is indicated, selection is installer's option; but, fixtures of same type must be furnished by a single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.
 - D. Provide fixtures complete with fittings, supports, fastening devices, bolt caps, faucets, valves, traps, stops and appurtenances.
- 2.3 CARRIERS
- A. Wall Hung Water Closets:
 1. Vertical: Zurn Z-1204-N4-X-50 or Z-1204-ND4-X-50 (JR Smith 230y-M54-M12 or 230DY-M54-M12). Adjustable vertical load siphon jet with 500 lb. capacity.

2. Horizontal: Zurn ZE-1203-N4-X-50 or ZE-1203-ND4-X-50 (JR Smith 220 R or L-Y-M54-M12 or 220DY-M54-M12). Adjustable horizontal siphon jet with 500 lb. load capacity.
 - B. Wall Hung Urinal: Zurn Z-1218-WS or Z-1222-WS. (JR Smith 637). Coupling type or plate type with bearing plate 200 lb. capacity.
 - C. Wall Hung Lavatory: Zurn Z-1231 (D). (JR Smith 700). Concealed arm or Plate type, 250 lb. capacity.
 - D. Wall Hung Service Sink: Zurn Z-1218. (JR Smith 913/914). Coupling type. 300 lb. capacity.
 - E. Wall Hung Drinking Fountain: Zurn Z-1225-BL (JR Smith 834-97-98). Plate type. 300 lb. capacity.
- 2.4 ELECTRIC WATER COOLERS
- A. See Schedule on Drawings for Type.
- 2.5 EMERGENCY SHOWERS/EYEWASH
- A. Provide emergency showers/eyewash products that are compliant with ANSI Z358.1, Standards for Emergency Eyewashes and Shower Equipment.
- 2.6 FIXTURE TRIM
- A. Traps: Provide heavy duty commercial grade traps on fixtures except fixtures with integral traps. Exposed traps will be chromium plated cast brass or 17 gauge chromium plated brass tubing.
 1. Sink: McGuire 8912-C-DF.
 2. Lavatory: McGuire 8902-C-DF.
 - B. Supplies and Stops: Lead free heavy duty commercial grade, chrome plated with brass stems. Stops: T-handle type.
 1. Lavatory: McGuire LFH 2165
 2. Sink: McGuire LFH 2167
 - C. Lavatory Grid Strainer: McGuire 155A.
 - D. Sink Grid Strainer: McGuire 152N.
 - E. Shower Grid Strainer: McGuire 1266.
 - F. Sink Basket Strainer: McGuire 151.
 - G. Trim barrier-free wrap for P-traps and supplies by McGuire, Pro-Wrap, Plumberex or True-bro.
 - H. Escutcheons: McGuire wrought brass deep bell.
 - I. Wax Rings and Toilet Bolts: WM Harvey No Seep No. 1 053065-N.
- 2.7 FLOOR AND AREA DRAINS
- A. See Schedule on Drawings for types.
- 2.8 FLOOR SINKS
- A. See Schedule on Drawings for types.
 - B. Plastic components are not allowed.

2.9 FLUSHOMETERS - WATER CLOSET/URINAL

- A. See Schedule on Drawings for types.

2.10 HOSE BIBBS

- A. See Schedule on Drawings for types.

2.11 WATER CLOSET SEATS

- A. See Schedule on Drawings for type.

2.12 DRAIN BOXES

- A. See Schedule on Drawings for Type.
- B. Provide fire rated ASTM E-84 rated boxes where required by building construction.

2.13 WATER SUPPLY BOXES

- A. See Schedule on Drawings for Type.
- B. Provide fire rated ASTM E-84 rated boxes where required by building construction.

PART 3 - EXECUTION

3.1 GENERAL PLUMBING FIXTURE INSTALLATION INFORMATION

A. Verification of Conditions:

1. Examine rough-in work of water supply and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping and other unsatisfactory conditions for installation of plumbing fixtures.
2. Examine walls, floors and cabinets for suitable conditions where fixtures are to be installed.
3. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings and pertinent codes and regulations, design and referenced standards.
4. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.
5. Install a stop valve in a readily accessible location in water connection to each fixture.
6. Install escutcheons at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Seal fixtures to walls and floors using silicone sealant Dow Corning No. 780 or approved equivalent. Match sealant color to fixture color.
8. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
9. Inspect each unit for damage prior to installation. Replace damaged fixtures.
10. Replace washers or cartridges of leaking or dripping faucets and stops.
11. Clean fixtures, trim and strainers using manufacturer's recommended cleaning methods and materials.
12. During construction, cover installed fixtures, drains, sinks and water coolers with cardboard and wrap with sheet plastic.
13. Provide trap primers for floor drains, floor sinks, trench drains and hub drains.

14. Install roof and overflow roof drains per architectural details. Cover drains during roof construction to protect drain. Provide offsets or expansion joints at each roof/overflow drain.
 15. Do not use lead flashing.
 - B. Owner Furnished Equipment:
 1. Rough-in and make final connections to Owner furnished equipment. Provide necessary items to complete installation.
 2. Comply with requirements of this Section and Drawings for installation procedures.
 - C. Adjusting and Cleaning: Clean plumbing fixtures, trim, and strainers of dirt and debris upon completion of installation. Adjust water pressure at drinking fountains, faucets, shower valves and flush valves to provide proper flow stream and specified GPM. Repair leaks at faucets and stops.
 - D. Extra Stock: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner.
 - E. Field Quality Control: Upon completion of installation of plumbing fixtures, test fixtures to demonstrate capability and compliance with Specifications. Correct or replace malfunctioning units at site, then retest to demonstrate compliance.
 - F. Protection: Protect fixtures and equipment from damage. Cover finished fixtures with cardboard and sheet plastic. Fixtures are not to be used during construction. Replace damaged items with new.
 - G. Signage: For fixtures that do not have ASSE 1070 mixing valve protection for hot water temperature, provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.
- 3.2 CARRIERS INSTALLATION
- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.
 - C. Coordinate wall thickness so carrier has adequate depth to be concealed.
- 3.3 ELECTRIC WATER COOLER INSTALLATION
- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.
- 3.4 EMERGENCY SHOWERS/EYEWASH INSTALLATION
- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.
- 3.5 FIXTURE TRIM INSTALLATION
- A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

- 3.6 FLOOR AND AREA DRAINS INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.
- 3.7 FLOOR SINK INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid. Set fixture rim/grate flush with surrounding finish surface unless specifically noted otherwise.
- 3.8 FLUSHOMETERS - WATER CLOSET/URINAL INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.
- 3.9 HOSE BIBB INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.
- 3.10 WATER CLOSET SEAT INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.
- 3.11 DRAIN BOX INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.
- 3.12 WATER SUPPLY BOX INSTALLATION
 - A. Install components in accordance with manufacturer's instructions and approved product data submittals.
 - B. Set plumb, level and rigid.

END OF SECTION

SECTION 230000 - HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Work included in 23 00 00, HVAC Basic Requirements applies to Division 23, HVAC work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of heating, ventilating and air conditioning systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work provided.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

- A. Contents of Section applies to Division 23, HVAC Contract Documents.
- B. Related Work:
 - 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 01, General Requirements, individual Division 23, HVAC Sections and those listed in this Section.

- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
1. State of Virginia:
 - a. 2015 Virginia Construction Code
 - 1) Adopts the 2015 International Building Code (IBC) with amendments
 - 2) Adopts the 2014 National Electrical Code (NEC) with amendments
 - b. 2015 Virginia Residential Code
 - 1) Adopts the 2015 International Residential Code (IRC) with amendments
 - c. 2015 Virginia Fuel Gas Code
 - 1) Adopts the 2015 International Fuel Gas Code (IFGC) with amendments
 - d. 2015 Virginia Mechanical Code
 - 1) Adopts the 2015 International Mechanical Code (IMC) with amendments
 - e. 2015 Virginia Plumbing Code
 - 1) Adopts the 2015 International Plumbing Code (IPC) with amendments
 - f. 2015 Virginia Statewide Fire Code
 - 1) Adopts the 2015 International Fire Code (IFC) with amendments
 - g. 2015 Virginia Energy Conservation Code
 - 1) Adopts the 2015 International Energy Conservation Code (IECC) with amendments
 - h. 2015 Virginia Existing Building Code
 - 1) Adopts the 2015 International Existing Building Code (IEBC) with amendments
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
1. ABA - Architectural Barriers Act
 2. ABMA - American Bearing Manufacturers Association
 3. ADA - Americans with Disabilities Act
 4. AHRI - Air-Conditioning Heating & Refrigeration Institute
 5. AMCA - Air Movement and Control Association
 6. ANSI - American National Standards Institute
 7. ASCE - American Society of Civil Engineers
 8. ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
 9. ASHRAE Guideline 0, The Commissioning Process
 10. ASME - American Society of Mechanical Engineers
 11. ASPE - American Society of Plumbing Engineers
 12. ASSE - American Society of Sanitary Engineering
 13. ASTM - ASTM International
 14. AWWA - American Water Works Association
 15. CFR - Code of Federal Regulations
 16. CGA - Compressed Gas Association
 17. CISPI - Cast Iron Soil Pipe Institute
 18. EPA - Environmental Protection Agency
 19. ETL - Electrical Testing Laboratories
 20. FM - FM Global
 21. GAMA - Gas Appliance Manufacturers Association
 22. HI - Hydraulic Institute Standards

23. IAPMO - International Association of Plumbing & Mechanical Officials
24. IFGC - International Fuel Gas Code
25. ISO - International Organization for Standardization
26. MSS - Manufacturers Standardization Society
27. NEC - National Electric Code
28. NEMA - National Electrical Manufactures Association
29. NFPA - National Fire Protection Association
30. NFGC - National Fuel Gas Code
31. NRCA - National Roofing Contractors Association
32. NSF - National Sanitation Foundation
33. OSHA - Occupational Safety and Health Administration
34. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
35. TEMA - Tubular Exchanger Manufactures Association
36. TIMA - Thermal Insulation Manufactures Association
37. UL - Underwriters Laboratories, Inc.

D. See Division 23, HVAC individual Sections for additional references.

1.4 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 23, HVAC Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail and be native/searchable PDF format. Scanned copies are not acceptable. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. At Contractor's option, four separate submittals may be provided, consisting of long lead items, underground/site work, building work, and building automation system. Deviations will be returned without review.
 3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 23, HVAC Sections.
 4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.

- a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 23, HVAC Specification Sections for specific items required in product data submittal outside of these requirements.
 - c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
 - d. For vibration isolation of equipment, list make and model selected with operating load and deflection.
 - e. See Division 23, HVAC individual Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
 6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
 7. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required by Division 23, HVAC Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
 8. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
 9. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
 10. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, equipment, ductwork and piping layout plans, and control

- wiring diagrams. Reference individual Division 23, HVAC Specification Sections for additional requirements for shop drawings outside of these requirements.
- a. Provide Shop Drawings indicating access panel locations for items that require Code or maintenance access, size and elevation for approval prior to installation.
11. Samples: Provide samples when requested by individual Sections.
 12. Resubmission Requirements:
 - a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 - 1) Resubmit for review until review indicates no exception taken or make "corrections as noted".
 - 2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
 13. Operation and Maintenance Manuals, Owner's Instructions:
 - a. Submit, at one time, electronic files (native/searchable PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
 - 3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Sections.
 - 4) Include product certificates of warranties and guarantees.
 - 5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 6) Include copy of startup and test reports specific to each piece of equipment.
 - 7) Include copy of final air and water systems balancing log along with pump, fan and distribution system operating data.
 - 8) Include commissioning reports.
 - 9) Include copy of valve charts/schedules.
 - 10) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

- b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 23 00 00, HVAC Basic Requirements Article titled "Demonstration".
 - c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
14. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules, control dampers, fire smoke dampers, fire dampers, valves, bottom of pipe, duct and equipment elevations and dimensioned locations for all distribution systems (hydronic and air). Invert elevations and dimensioned locations for underground systems below grade to 5-feet outside building that accurately reflect "as constructed or installed" for project.
 - c. At completion of project, input changes to original project Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit Revit Model and drawings upon substantial completion.
 - d. See Division 23, HVAC individual Sections for additional items to include in record drawings.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

- F. Provide products that are UL listed.
- G. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.
- H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.6 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

- A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 23, HVAC to combine information furnished by other trades onto master coordination documents.
- B. Prepare Drawings as follows:
 - 1. Drawings in Revit Model. Revit Model release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
 - 2. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
 - 3. Indicate hydronic and air distribution system piping including fittings, hangers, access panels, valves, and bottom of pipe and duct elevations above finished floor.
 - 4. Indicate inverts and provision for piping that must be graded to have right-of-way over more flexible items. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC equipment, ductwork and piping.
 - 5. Incorporate Addenda items and change orders.

6. Distribute drawings to trades and provide additional coordination as requested by other trades.
- C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- D. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL listed and labeled or be approved by State, County, and City authorities prior to procurement and installation.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 1. Comply with local, State of Virginia, and Federal regulations relating to hazardous materials.
 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions including all appurtenances recommended in manufacturer's installation

instructions, at no additional charge to Owner. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.

D. Earthwork:

1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:

1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Pipe Installation:

1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, flexible joints, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
2. Include provisions for servicing and removal of equipment without dismantling piping.

G. Plenums:

1. Plenums: Materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723. Immediately notify Architect / Engineer of any discrepancy.

3.2 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground system installation prior to backfilling.
 - 2. Prior to covering walls.
 - 3. Prior to ceiling cover/installation.
 - 4. After major equipment is installed.
 - 5. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Final Punch:
 - 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Mechanical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the mechanical systems are ready for final punch.
 - 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.3 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
 - 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping and ductwork, and wiring to point of connection. Where existing systems are being utilized, clean existing distribution systems (ductwork, piping, fans, air handlers) prior to connecting new ductwork or piping.
 - 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 - 4. Organize work to minimize duration of power interruption.

3.4 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 - 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section

will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.

3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.5 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.
- B. Maintain design intent where equipment other than as shown as Basis of Design in Contract Documents is provided. Where equipment requires ductwork or piping arrangement, controls/control diagrams, or sequencing different from that indicated in Contract Documents, provide at no additional cost to Owner.

3.6 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage to be replaced before installation.
 2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bright finished shafts, bearing housings and similar items until in service.

3.7 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to

satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.8 CLEANING

- A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.9 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
 - 1. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.
- D. Provide miscellaneous supports/metals required for installation of equipment, piping and ductwork.

3.10 PAINTING

- A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in mechanical rooms, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. After acceptance by Authority Having Jurisdiction (AHJ), In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Piping and Ductwork: Clean, primer coat and paint exposed piping and ductwork on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
 - 6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.11 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing and Balancing Reports
 - b. Cleaning
 - c. Operation and Maintenance Manuals
 - d. Training of Operating Personnel
 - e. Record Drawings
 - f. Warranty and Guaranty Certificates
 - g. Start-up/Test Document
 - h. Commissioning Reports

3.12 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Tests:
 - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Operation and Maintenance Manuals.
 - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.13 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that HVAC items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.14 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

3.15 TEMPORARY HEATING, COOLING AND HUMIDITY CONTROL

- A. Provide temporary heating, cooling, controls, humidification and dehumidification as required to facilitate the construction of the project. Size and select temporary system based on the requirements of the various trades during construction. This includes, but is not limited to, drywall, case work, wood flooring and wood finishes that are subject to warping. Size and install system to prevent mold growth. Coordinate the location of the temporary system. The house system can be used. Develop a procedure for how the house system will be used including a sketch depicting the house system, how filtration will be used to prevent construction debris from entering the system and how often the filters will be changed, how the ductwork will be cleaned after use to ensure a clean system is turned over to the Owner and how the units are sized. Submit this procedure to the Mechanical Engineer for review. Follow National Air Duct Cleaners Association (NADCA) duct cleaning procedures and guidelines. Warranties for the house system, if new, to commence when the Owner moves in if house system is used as the means to maintain the climate within the building during construction. Include this warranty requirement in the original bid or proposal amount. Coordinate and provide any temporary power, controls, ductwork, piping, plumbing anchorage, miscellaneous steel and structural supports required to support the temporary system. Installation of the system to comply with all applicable codes and be acceptable to the Authority Having Jurisdiction (AHJ).

END OF SECTION

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:

1. Hangers and Supports for HVAC Piping, Ductwork and Equipment
2. Wall and Floor Sleeves
3. Building Attachments
4. Flashing
5. Miscellaneous Metal and Materials

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
1. ASCE 7-16, Minimum Design Loads for Buildings and Other Structures.
 2. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
 3. Install ductwork and piping per SMACNA's requirements.
 4. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
1. Welding:
 - a. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications".
 2. Welding for Hangers:
 - a. Qualify procedures and personnel according to AWS D9.1, Sheet Metal Welding Code for duct joint and seam welding.
 3. Engineering Responsibility:
 - a. Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, duct support equipment hangers/supports, support from floor structure, roof structure or from structure above, and restraint by a qualified Structural Professional Engineer.
 - 1) 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 hangers and supports that are similar to those indicated for this Project in material, design, and extent.

4. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
5. Support systems to be supplied by a single manufacturer.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

- A. Provide pipe, ductwork and equipment hangers and supports in accordance with the following:
 1. When supports, anchorages, and restraints for equipment, and supports, anchorages, and restraints for conduit, piping, and ductwork are not shown on the Drawings, the contractor is responsible for their design.
 2. Connections to structural framing not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems:
 1. Support frames such as pipe racks or stanchions for piping, ductwork, and equipment which provide support from below.
 2. Equipment, ductwork and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- E. Provide restraint hangers and supports for piping, ductwork and equipment. See Section 230548, Vibration Controls for HVAC Equipment.
- F. Obtain approval from AHJ for restraint hanger and support system to be installed for piping and equipment. See Section 230548, Vibration Controls for HVAC Equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Hangers and Supports for HVAC Piping, Ductwork and Equipment:
 1. Anvil International
 2. B-Line Systems, Incorporated
 3. Erico Company, Incorporated
 4. Nelson-Olsen Incorporated
 5. Rilco Manufacturing Company, Incorporated
 6. Snappitz Thermal Pipe Shield Manufacturing
 7. Unistrut Corporation
- B. Wall and Floor Sleeves:

1. Thunderline Corporation "Link Seal".
 2. Or approved equivalent.
- C. Building Attachments:
1. Anchor-It
 2. Gunnebo Fastening Corporation
 3. Hilti Corporation
 4. ITW Ramset/Red Head
 5. Masterset Fastening Systems, Incorporated

2.2 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

- A. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
- B. Hanger Rod Couplings: Anvil Figure 136, B-Line Figure B3220, or approved equivalent; malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
- C. Channel Hanging System:
1. Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A1011 Grade 33, one side of channel to have a continuous slot within turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
 2. Concrete Inserts: Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.
- D. Continuous Concrete Insert: Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
- E. Pipe Hangers:
1. Pipe Rings for Hanger Rods:
 - a. Pipe Sizes 2-inches and Smaller: Adjustable swivel ring hanger, UL listed. Erico 100 or 101, Anvil Figures 69 or 104, or approved equivalent.
 - b. Pipe Sizes 2-1/2-inches and Larger: Clevis type hangers with adjustable nuts on rod, UL listed. Anvil figure 260, Erico 400, or approved equivalent.
 - c. Pipe hangers to have same finish as hanger rods.
- F. Pipe Saddles and Shields:
1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
 2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
- G. Riser Clamps: Steel, UL listed. MSS Type 8. Erico 510 or 511. Copper coated; Erico 368.
- H. Pipe Slides: Anvil, reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resist corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.
- I. Pipe Guides:

1. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Contact with chilled water pipe not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 2. Furnish and install guides approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.
- J. Pipe Roller Hangers: Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.
- K. Below Ground Pipe Supports:
1. Pipe Hangers All Sizes: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 304. MSS Type 1. Erico 406.
 2. Rod: 5/8-inch stainless steel Type 18-8.
 3. Eyebolt: Stainless steel Type 18-8.
 4. Nuts and Washers: Stainless steel Type 18-8.
- L. Thermal Hanger Shield Inserts:
1. 100-PSI (690-kPa) minimum compressive strength calcium silicate insulation, encased in sheet metal shield or polyisocyanurate rigid foam exceeding the load bearing weight of the pipe at the hanger point with a PVC vapor barrier.
 2. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier or polyisocyanurate rigid foam with a PVC vapor barrier.
 3. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate or polyisocyanurate rigid foam with a PVC vapor barrier.
 4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 6. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
 7. Thermal Hanger Shield Insulation Operating Temperature: Meet or exceed fluid temperature in pipe.
- M. Freestanding Roof Supports: Polyethylene high-density UV resistant quick "pipe" block with foam pad.

2.3 WALL AND FLOOR SLEEVES

- A. Below Grade or High Water Table Areas:
1. "Link-Seal" Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal.
 2. Provide Type S unless otherwise noted.
- B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.
- C. Fabricated Accessories:
1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
 2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide the following minimum gauges for the sizes indicated:
 - a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.

- b. Sleeve Sizes 5-6-inches: 16 gauge.
- c. Sleeve Sizes 7-inches and Larger: 14 gauge.
- d. Fire-Rated Safing Material.
 - 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 pounds per cubic foot density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
 - 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.4 BUILDING ATTACHMENTS

- A. Beam Clamps:
 - 1. MSS Type 19 and 23, wide throat, with retaining clip.
 - 2. Universal Side Beam Clamp: MSS Type 20.
- B. Powder-Actuated Drive Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Anchor Bolts:
 - 1. Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer. Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
 - 2. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 - 3. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 - 4. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.

2.5 FLASHING

- A. Steel Flashing: 26 gauge galvanized steel.
- B. Safes: 8 mil thick neoprene.
- C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.

2.6 MISCELLANEOUS METAL AND MATERIALS

- A. General:
 - 1. Provide miscellaneous supports and metal items, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on drawings or otherwise not shown on drawings that are necessary for completion of the project. Contractor is responsible for their design.
 - 2. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

- B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.
- G. Provide hot dipped galvanized components for items exposed to weather. Cold galvanize field-welded joints and components. Use materials compatible with system being supported (i.e. aluminum for aluminum ductwork, stainless steel for stainless steel ductwork).
- H. Use straps, threshold rods and wire with sizes required by SMACNA to support ductwork.
- I. Grout:
 - 1. ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 - 2. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 3. Properties: Nonstaining, noncorrosive, and non gaseous.
 - 4. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.
- B. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall", "2-Hour Fire/Smoke Barrier", and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.
- C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate proper placement of inserts, anchors and other building structural attachments.
- D. Equipment Clearances: Do not route ductwork, equipment, or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-foot lateral clearance from all sides of electric switchgear panels. Do not route ductwork, equipment, or piping above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact ductwork, equipment or pipe routing to provide proper clearance with such items.

3.2 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

- A. Hang rectangular sheet-metal ducts with a cross sectional area of less than 7 SF with galvanized strips of No. 16 USS gauge steel 1-inch wide, and larger ducts with steel angles and adjustable hanger rods similar to piping hangers. Support at a maximum of 8-feet on center.
- B. Support horizontal ducts within 24-inches of each elbow and within 48-inches of each branch intersection.
- C. Design hangers and supports to allow for expansion and contraction.
- D. Provide aluminum supports for aluminum ductwork.
- E. Provide stainless steel supports for stainless steel ductwork.
- F. Support vertical ducts at maximum intervals of 16-feet and at each floor.
- G. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- H. Install flexible ductwork per the more stringent of SMACNA HVAC Duct Construction Standards or the following:
 - 1. Support horizontal duct runs at not more than 4 feet intervals.
 - 2. Support vertical risers at not more than 6 feet intervals.
 - 3. Limit sag between support hangers to 1/2-inch per foot of spacing support.
 - 4. Supports shall be rigid and shall be not less than 1.5-inches wide at point of contact with the duct surface.
 - 5. Duct bends shall be not less than 1.5 duct diameter bend radius.
- I. Use double nuts and lock washers on threaded rod supports.
- J. Floor supports in mechanical rooms to be elevated 1-inch above finish floor and void space filled with masonry grout.
- K. Anchor ducts securely to building in such a manner as to prevent transmission of vibration to structure. Do not connect duct hanger straps directly to roof deck. Do not support ducts from other ducts, piping or equipment.
- L. Attach strap hangers installed flush with end of sheet-metal duct run to duct with sheet-metal screws.
- M. Construct exterior ductwork or ductwork which is otherwise exposed to weather watertight and slope 1/4-inch per foot to avoid standing water.
- N. Exposed ductwork hung in clean areas such as sanitary areas, pharmaceutical areas, wash down areas or food process areas to be installed using double end, food grade trapeze hanger rods suitable for use with food grade strut.
- O. Channel Support System Installation:
 - 1. Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 - 2. Field assemble and install according to manufacturer's written instructions.
- P. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

- Q. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- R. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- S. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping, ductwork and equipment to proper level and elevations.
- T. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.
- U. Horizontal Piping Hangers and Supports; Horizontal and Vertical Piping, and Hanger Rod Attachments:
 - 1. Factory fabricated horizontal piping hangers and supports complying with MSS SP-58, to suit piping systems and in accordance with manufacturer's published product information.
 - 2. Use only one type by one manufacturer for each piping service.
 - 3. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping.
 - 4. Pipe support spacing (pipe supported in ceiling or floor-supported) to meet latest applicable Code and manufacturer's requirements.
 - 5. Provide copper-plated hangers and supports for uninsulated copper piping systems.
- V. Plumber's Tape not permitted as pipe hangers or pipe straps.
- W. Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.
- X. Pipe Ring Diameters:
 - 1. Uninsulated and Insulated Pipe, Except Where Oversized Pipe Rings are Specified: Ring inner diameter to suit pipe outer diameter.
 - 2. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.
- Y. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.
- Z. Pipe Support Brackets: Support pipe with pipe slides.
- AA. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.
- AB. Pipe Guides:
 - 1. Install on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Contact with chilled water pipe does not permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - 2. Install approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.
- AC. Heavy-Duty Steel Trapeze Installation:
 - 1. Arrange for grouping of parallel runs of horizontal piping and support together on field fabricated, heavy-duty trapezes.

2. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 3. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- AD. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers. Maximum spacings: MSS SP-58.
- AE. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.
- AF. Do not support piping from other piping.
- AG. Fire protection piping will be supported independently of other piping.
- AH. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
- AI. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.
- AJ. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 2. Do not exceed pipe stress limits according to ASME B31.9.
 3. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 4. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields to span arc of 180 degrees.
 5. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
 6. Shield Dimensions for Pipe, not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
 - b. NPS 4 (DN100): 12-inches long and 0.06-inch thick.
 - c. NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
 - d. NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
 - e. NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
 7. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
 - a. Insert Material: Length at least as long as protective shield.
 8. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- AK. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.
- AL. Pipe Curb Assemblies:
1. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.

2. Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., piping, electrical power and control wiring). Meet requirements of roof warranty.

AM. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor walls, and through equipment room walls and floors.

AN. Vertical Piping:

1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
2. Riser clamps to be directly under fitting or welded to pipe.
 - a. Riser to be supported at each floor of penetration.
 - b. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.

AO. Piping Above Roof:

1. Provide engineered roof piping supports appropriate for installation and attachment to the roof structure or structure below roof (see Architectural and Structural Drawings for roof construction, building structural systems, and sloping requirements for insulation).
2. Design a complete system unless specific details have been shown on Drawings.
3. Provide calculations signed and stamped by a Structural Engineer, registered in the State where the project is located at, as part of submittals and coordinated shop drawings.
4. Do not use freestanding supports unless approved by the Structural Engineer of Record.
5. Provide miscellaneous metal and materials as specified in Miscellaneous Metal and Materials article, above.

3.3 WALL AND FLOOR SLEEVES

- A. "Link-Seal" Pipe Sleeves: Install at floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.
- B. Fabricated Pipe Sleeves:
 1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local clearance requirements, and by waterproofing requirements.
 2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
 3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
 4. Seal each end airtight with a resilient nonhardening sealer, UL listed, fire rated ASTM 814.
- C. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
 1. Install fabricated pipe sleeve.
 2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
 3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814.
- D. Piping Penetrations Through Fire-Rated (One to Three Hour) Assemblies:

1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.
2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814.

3.4 BUILDING ATTACHMENTS

- A. Factory fabricated attachments complying with MSS SP-58, selected to suit building substructure conditions and in accordance manufacturer's published product information.
- B. Select size of building attachments to suit hanger rods.
- C. Space attachments within maximum piping span length indicated in MSS SP-58.
- D. Install building attachments within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.
- E. Attachment to Wood Structure: Anvil side beam bracket Figure 202 for attachment to wooden beam or approved attachment for a wood structure.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install concrete inserts before concrete is placed; fasten inserts to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.
- H. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Test powder-actuated insert attachments with a minimum load of 100 pounds.
- I. Do not use powder-actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4-inches thick.
- J. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.
- K. Anchor Bolts:
 1. Install anchor bolts for mechanical equipment, piping and ductwork as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment, piping and ductwork are hung.
 2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.

3.5 FLASHING

- A. Flash and counterflash where piping, ductwork and equipment passes through weather or waterproofed walls, floors, and roofs.
- B. Provide 12-inch minimum height curbs for roof-mounted mechanical equipment. Flash and counter flash with galvanized steel, soldered and waterproofed.

3.6 MISCELLANEOUS METAL AND MATERIALS

- A. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
- B. Finishes:
1. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
 2. Metal in Contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
 3. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.
- C. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.
- E. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items, which are to be built into concrete masonry or similar construction.
- F. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

- G. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
 - H. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.
 - I. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
 - J. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
 - K. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
 - L. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
 - M. Provide galvanized components for items exposed to weather.
- 3.7 FIRE RATED SUPPORTS
- A. Provide fire rated support as required by Codes.

END OF SECTION

SECTION 230548 - VIBRATION CONTROLS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Vibration Isolation
 - 2. Factory Finishes
- B. General:
 - 1. Vibration isolation for mechanical ductwork, piping and equipment.
- C. Scope of Work:
 - 1. Vibration isolation of new equipment and systems in existing buildings to points of connection with existing systems.

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Vibration Isolation:
 - a. Product Data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.
 - b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:
 - 1) Fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment and cantilever loads.
 - 2) Equipment mounting holes.
 - 3) Dimensions.
 - 4) Size and location of concrete and steel bases and curbs.
 - 5) Isolation selected for each support point.
 - 6) Details of mounting brackets for isolator.
 - 7) Weight distribution for each isolator.
 - 8) Code number assigned to each isolator.
 - c. Design calculations: Provide calculations for selecting vibration isolators and for designing vibration isolation bases.
 - 2. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Vibration Isolation:
 - a. Except for packaged equipment with integral isolators, single manufacturer selects and furnishes isolation required.
 - b. Deflections indicated on drawings are minimum actual static deflections for specific equipment supported.
 - c. Isolator Stability:
 - 1) Size springs of sufficient diameter to maintain stability of equipment being supported. Spring diameters not less than 0.8 of compressed height at rated load.
 - 2) Springs have minimum additional travel to solid equal to 50 percent of rated deflection.
 - 3) Springs support 200 percent of rated load, fully compressed, without deformation or failure.
 - d. Maximum Allowable Vibration Levels: Peak vibration velocities not exceed 0.08 in/sec. Correct equipment operating at vibration velocities that exceed this criteria.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Vibration Isolation:
 - 1. The VMC Group
 - 2. B-Line Systems, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
 - 5. M.W. Saussé - Vibrex
 - 6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
- B. Factory Finishes:
 - 1. Kynar 500 Fluoropolymer Coating
 - 2. Or approved equivalent.

2.2 VIBRATION ISOLATION

- A. Type 1 - Neoprene Pad: Natural rubber waffle pads, arranged in single or multiple layers, 3/4-inch thick per layer with pattern repeating on 1/2-inch centers; 50 durometer hardness; maximum loading 60 PSI. Minimum 1/4-inch thick steel load distribution plate and 1/16-inch shim plates between layers, factory cut to sizes matching requirements of supported equipment. Molded bridge with neoprene anchor bolt bushing and flat washer face to prevent metal to metal contact. Number of layers required for equipment scheduled. Mason Type: Super WMH.

- B. Type 2 - Neoprene Mount: Double-deflection type, with ductile-iron housing containing two separate and opposing, oil-resistant natural rubber or bridge bearing neoprene elements, factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Neoprene elements to prevent metal to metal contact during normal operation. Minimum static deflection of 0.30-inches. Mason Type: BR.
- C. Type 3 - Spring: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 2. Minimum Additional Travel: 50 percent of required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside. Baseplates limit floor load to 100 PSIG (690 kPa).
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
 7. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
 8. Mason Type: SLFH or SLF.
- D. Type 5a - Restrained Elastomeric Hangers: Double-deflection type, with molded, oil-resistant natural rubber or bridge bearing neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range. Seismic rebound steel and bonded LDS rubber washer to limit upward seismic movement. Mason Type: RWHD.
- E. Type 5b - Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 15 degrees of angular hanger-rod misalignment from vertical without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Mason Type: 30N.
- F. Type FC-1, Flexible duct connectors. See Specification Section 23 33 00 Air Duct Accessories.
- G. Type FC-3, Flexible Compensator, Double Sphere:
1. Body: Molded twin spherical type. Neoprene with internal cord or wire.
 2. Minimum Pressure Rating, Sizes 2-inch to 12-inch: 225 PSI at 170 degrees F.
 3. Minimum Pressure Rating, Sizes 14-inch to 20-inch: 125 PSI at 170 degrees F.
 4. Minimum Allowable Compression: 1-1/2 inches.

5. Minimum Allowable Elongation: 1-1/8 inches.
6. Minimum Allowable Offset: 1-1/8 inches.
7. Minimum Allowable Angular Movement: 20 degrees.
8. Joint: Steel flanges.
9. Accessories: Galvanized aircraft-type cable or control rods to prevent over extension.
10. Basis of Design: Metraflex Doublesphere.

2.3 FACTORY FINISHES

- A. Provide manufacturer's standard prime-coat finish ready for field painting. Units mounted outdoors exposed to weather: Epoxy powder coated, with 1000 hour salt spray rating per ASTM B-117. For high levels of corrosion protection utilize:
 1. Conform to AAMA 605.2.
 2. Apply coating following cleaning and pretreatment.
 3. Cleaning: AA-C12C42R1X.
 4. Dry system before final finish application.
 5. Total Dry Film Thickness: Approximately 1.2 mils, when baked at 450 degrees F for 10 minutes.
- B. Finish:
 1. Manufacturer's standard paint applied to factory-assembled and factory-tested equipment before shipping.
 2. Powder coating on springs and housings.
 3. Hardware be electrogalvanized. Hot-dip galvanize metal components for exterior use.
 4. Baked enamel for metal components on isolators for interior use.
 5. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Set floor-mounted equipment with steel base rails on minimum 4-inch-high concrete housekeeping pads. Extend pad minimum 6-inches beyond footprint of equipment in each direction, but not less than twice the embedment depth of concrete anchors.
- B. Provide mounts for equipment installed outdoors for wind loads of 30 lbs. psf applied to any exposed surface of isolated equipment.
- C. Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, etc.
- D. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances is isolation efficiency to be destroyed when bolting isolators to floor.
- E. Building Penetrations: Isolate water piping and ductwork penetrating wall, ceilings, floors or shafts from structure by piping isolator or by 3/8-inch thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe or duct at equipment room wall.
- F. Provide roof curbs, equipment supports and roof penetrations. Work to maintain roof warranty. Coordinate location, size, structural connections/requirements and flashing prior to installation.

- G. Vibration isolators must not cause change of position of equipment or piping which would stress piping connections or misalignment shafts or bearings. Isolated equipment is to be level and in proper alignment with connecting ducts and pipes.
- H. Examination:
 - 1. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances and other conditions affecting performance.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- I. Testing: Perform following field quality-control testing:
 - 1. Isolator seismic-restraint clearance.
 - 2. Snubber minimum clearances.
- J. Adjusting:
 - 1. Adjust snubbers according to manufacturer's written recommendations.
 - 2. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.
- K. Cleaning: After completing equipment installation, inspect vibration isolation. Remove paint splatters and other spots, dirt and debris.
- L. Demonstration: Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain air-mounting systems. Reference Division 01, General Requirements.

3.2 VIBRATION ISOLATION

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Vibration isolators must be installed in strict accordance with manufacturer's written instructions and certified submittal data.
- D. Install isolation by type and location and where indicated below.
- E. Equipment Vibration Isolation Schedule:

Equipment	Size	Vibration Isolator Type	Minimum Deflection (in)
Fan-coils, Unit Heaters, Fan-Powered Terminal Units	All	Type 5B, FC-1	0.75
Condensing Units	0 to 4.5 tons	Type 1	0.3

- F. Isolation Mounts:
 - 1. Install minimum of four seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts.
 - 3. Provide flexible piping connection and flexible ductwork connection to equipment with isolation mounts or bases.

G. Isolating Hangers:

1. Support piping and ductwork connected to isolated equipment within equipment rooms on isolating hangers. Unless otherwise noted, first three hangers from isolated equipment to have a minimum of 1/2 static deflection of equipment isolators. Other isolating hangers to have a minimum of 1/4 static deflection of equipment isolators.
2. Position isolating hanger elements as high as possible in hanger rod assembly, but not in contact with building structure. Install hangers so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.
3. Unless otherwise noted, air supply units with internally isolated fans do not require isolating hangers for connecting pipes and ductwork.
4. Where parallel running pipes are hung together on an isolated trapeze, provide isolator deflections for largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes in same trapeze.

H. Adjusting:

1. Adjust isolators after piping systems have been filled and equipment is at operating weight.
2. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

3.3 FACTORY FINISHES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Finishes to be factory-applied. No field patching or holidays allowed.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Plastic Nameplates
 - 2. Ceiling Tags

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Schedules:
 - a. Submit valve schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals.
 - b. For renovations or expansions of existing systems, coordinate with Owner and develop valve schedule on existing schedule naming and format.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
 - 2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01 General Requirements.
- B. In addition, provide:
 - 1. Submit schedule of identification type, including material, for each class of tagged item.

2. Submit locations at which Valve Schedules will be installed.

PART 2 - PRODUCTS

2.1 PLASTIC NAMEPLATES

- A. Manufacturers:
 1. Brady Corporation
 2. Brimar
 3. Champion America
 4. Craftmark
 5. Seton
- B. Description: Engraving stock melamine plastic laminate in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Provide 1/8-inch thick material.
 1. Letter Color: White.
 2. Letter Height: 1/2-inch.
 3. Background Color: Black.
 4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
 5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.

2.2 CEILING TAGS

- A. Manufacturers:
 1. Brady Corporation
 2. Brimar
 3. Champion America
 4. Craftmark
 5. Seton
- B. Description: Steel with 3/4-inch diameter color coded head.
- C. Color code as follows:
 1. Yellow - HVAC equipment.
 2. Red - Fire dampers/smoke dampers.
 3. Blue - Heating/cooling valves.
 4. Ceiling tile labels, machine generated, adhesive backed tape labels with black letters, clear tape.

PART 3 - EXECUTION

3.1 GENERAL - INSTALLATION

- A. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates riveted to equipment body.
- B. Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by

manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

- C. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).
- D. Degrease and clean surfaces to receive adhesive for identification materials.
- E. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- F. Coordinate with the facility maintenance personnel to ensure consistency with the existing tagging system.
- G. Install all products in accordance with manufacturer's instructions.
- H. Manual Balancing Dampers: Provide 12-inch long orange marker ribbon to end of balancing damper handle.

3.2 PLASTIC NAMEPLATES

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners.
- B. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.
- C. Identify thermostats with nameplates.

3.3 CEILING TAGS

- A. Provide ceiling tags to locate valves, dampers, and equipment above accessible ceilings. Locate in corner of ceiling tee grid closest to equipment.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General Requirements and Procedures
 - 2. Ductwork Pressure Testing
 - 3. Fundamental Air Systems Balancing Procedures
 - 4. Temperature Control Verification
 - 5. Constant Volume Air Systems Balancing Procedures
 - 6. Pre-Balance Reporting
 - 7. Final Reports:
 - a. Report Requirements
 - b. General Report Data
 - c. System Diagrams
 - d. Air Handling Units
 - e. Fans
 - f. Duct Traverses
 - g. Diffusers/Registers/Grilles
 - h. Instrument Calibration
 - 8. Additional Tests

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Quality-Assurance Submittals: Submit two copies of evidence that the Testing, Adjusting, and Balancing (TAB) Agent and Project's TAB team members meet the qualifications specified in the "Quality Assurance" Article below.
 - 2. Pre-Construction Phase Report:
 - a. Provide a pre-construction phase TAB Plan at least two weeks prior to the commencement of TAB work. This report is to include:
 - 1) A complete set of report forms intended for use on the Project, with data filled in except for the field readings. Forms to be Project-specific.
 - 2) Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
 - 3) Identification of the type, manufacturer, and model of the actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications to be included.

- 4) A narrative of Project-specific and/or non-standard TAB procedures to be used, and the equipment or systems to which they apply.
3. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit two copies of the Contract Documents review report as specified in Part 3 of this Section.
4. Strategies and Procedures Plan: Submit two copies of the TAB strategies and step-by-step procedures as specified in Part 3 of this Section. Include a complete set of report forms intended for use on this Project.
5. Specify reports required because of editing procedures in Part 3 of this Section.
6. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by the TAB Agent.
7. Sample Report Forms: Submit two sets of sample TAB report forms.
8. Test Instrument Calibration: Submit proof of calibration within the last 6 months.
9. Final Report.
10. Provide additional submittals to commissioning authority as dictated in Commissioning Specifications.

1.5 QUALITY ASSURANCE

- A. Quality Assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 1. Balance Firm Qualifications:
 - a. General:
 - 1) Procure services of independent TAB agency to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems. Minimum experience: 5 years.
 - 2) Provide proof of testing agency having successfully completed at least five projects of similar size and scope.
 - b. Testing and Balancing firm is certified by NEBB or AABC and has a NEBB Certified Professional (CP) or a AABC Test and Balancer Engineer (TBE) on staff.
 - c. Industry Standards: Testing and Balancing will conform to NEBB or AABC, and American National Standards Institute (ANSI) as follows:
 - 1) NEBB: Comply with Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
 - 2) AABC: Comply with National Standards for Total System Balance.
 - 3) ANSI:
 - (a) S1.4 Specifications for sound level meters.
 - (b) S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.
 - (c) ANSI S1.13 Methods for the Measurement of Sound Pressure Levels.
 - d. Test Observation: If requested, conduct tests in the presence of the Commissioning Authority, AHJ, Architect or the Architect's representative.
 2. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
 3. Owner Witness: Perform tests in the presence of the Commissioning Authority, Architect, Architect's Representative, or Owner's representative.

4. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
5. Simultaneous Testing: Test observations by the AHJ, the Owner's Authorized Representative and the engineer's representative need not occur simultaneously.
6. Do not perform TAB work until heating, ventilating, and air conditioning equipment has been completely installed and is operating continuously as required.
7. Conduct air testing and balancing with clean filters in place. Clean strainers prior to performing hydronic testing and balancing.
8. TAB Conference: Meet with the Commissioning Authority, Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.
 - a. Agenda Items: Include at least the following:
 - 1) Submittal distribution requirements.
 - 2) Contract Documents examination report.
 - 3) TAB plan.
 - 4) Work schedule and Project site access requirements.
 - 5) Coordination and cooperation of trades and subcontractors.
 - 6) Coordination of documentation and communication flow.
9. Certification of TAB Reports: This certification includes the following:
 - a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
10. TAB Reports: Use standard forms from NEBB or AABC.
11. Instrumentation Type, Quantity, and Accuracy: As described in NEBB or AABC.
12. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 1. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of outlet, coil, or device listed in the final TAB report.
 2. Guarantee: Meet the requirements of the following programs:
 - a. Provide a guarantee on NEBB or AABC forms stating that the agency will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1) The certified Agent has tested, adjusted, and balanced systems according to the Contract Documents.
 - 2) Systems are balanced to optimum performance capabilities within design and installation limits.

1.7 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. TAB: Testing, Adjusting, and Balancing.
- K. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- L. Test: A procedure to determine quantitative performance of a system or equipment.
- M. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.
- N. AABC: Associated Air Balance Council.
- O. NEBB: National Environmental Balancing Bureau.
- P. AMCA: Air Movement and Control Association.
- Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.8 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
- C. Witness leakage and pressure tests carried out by Section 23 31 00, HVAC Ducts and Casings.
- D. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS AND PROCEDURES

A. Project Conditions:

1. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner's operations.

B. General Requirements:

1. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and controls, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
2. Perform TAB work with doors, closed windows, and ceilings installed etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for TAB are clean and free from debris, dirt and discarded building materials.
3. Where Owner occupies building during the testing period, cooperate with Owner to minimize conflicts with Owner's operations.

C. Examination:

1. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - a. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - b. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
2. Examine approved submittal data of HVAC systems and equipment.
3. Examine Project record documents described in Division 01, General Requirements.
4. Examine Architect's and Engineer's design data, including Basis of Design, HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
5. Examine equipment performance data, including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
6. Coordinate requirements in system and equipment with this Section.

7. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
8. Examine system and equipment test reports.
9. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
10. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
11. Examine equipment for installation and for properly operating safety interlocks and controls.
12. Report deficiencies discovered before and during performance of TAB procedures.

D. Preparation:

1. Prepare a TAB plan that includes strategies and step-by-step procedures.
2. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - a. Permanent electrical power wiring is complete.
 - b. Hydronic systems are filled, clean, and free of air.
 - c. Automatic temperature-control systems are operational.
 - d. Equipment and duct access doors are securely closed.
 - e. Balance, smoke, and fire dampers are open.
 - f. Isolating and balancing valves are open and control valves are operational.
 - g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - h. Windows, doors and other portions of the building envelope can be closed so design conditions for system operations can be met.
3. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - a. Attendance is required by installers whose work will be tested, adjusted, or balanced.
4. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.

E. General TAB Procedures:

1. Perform TAB procedures on each system according to the procedures contained in NEBB or AABC and this Section.
2. Coordinate location of test probes prior to start of TAB procedures and make test probes available for Owner's tests after start of occupancy. Where required, cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
3. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

- F. Adjustment Tolerances:
1. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
 2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
 3. Adjust supply, return, and exhaust air quantities to maintain pressurization in spaces indicated on Drawings. Note and document room-to-room pressurization and maintain these relationships. Adjust pressure controlled spaces to within plus or minus 0.01 in WC.
- G. Recording and Adjusting:
1. Field Logs: Maintain written logs including:
 - a. Running log of events and issues.
 - b. Discrepancies, deficient or uncompleted work by others.
 - c. Contract interpretation requests.
 - d. Lists of completed tests.
 2. Ensure recorded data represents actual measured or observed conditions.
 3. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
 4. Mark on drawings locations where traverse and other critical measurements were taken and cross reference location in final report.
 5. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
 6. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
 7. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner's Authorized Representative, or Commissioning Agent.

3.2 DUCTWORK PRESSURE TESTING

- A. Test ductwork prior to connection to fan equipment. Repair leaks and retest until stipulated results are achieved.
- B. Provide air pressure testing of ductwork as noted below for various project types and systems:
1. Supply and return ductwork located inside shafts and outside building envelope.
 2. Exhaust ductwork located inside shafts.
 3. Exhaust ductwork located outside building envelope, when used in a heat recovery system.
 4. For low-rise and high-rise multi-family, and single-residence Dwelling Units: not required.
 5. Exhaust systems serving compounding pharmacies, laboratories, laboratory support spaces, fume hoods, bio-safety cabinets, or hazardous exhausts: pressure test all ductwork.
 6. For other project types or systems: pressure test ductwork in accordance with SMACNA HVAC Air Duct Leakage Test Manual, of representative sections of installed ductwork totaling not less than the total installed duct areas noted below:
 - a. For variable air volume supply, return, or exhaust air systems' ductwork of higher than 2-inches pressure class: pressure test 40 percent of the total installed duct area.

- b. For variable air volume supply, return, or exhaust air systems' ductwork of 2-inches or less pressure class: pressure test ductwork connected to 10-percent of the total installed duct area of such ductwork, but not less than ductwork connected to two terminal units. Where the tested 10-percent fails to comply, then pressure test 40-percent of the total installed duct area.
- c. For constant air volume supply, return, or exhaust systems: pressure test 40-percent of the total installed duct area.
- 7. Where tests are required, provide separate tests for each of supply, return and exhaust air systems.
- 8. Where the tested 40-percent fails to comply with the requirements of this section, then pressure test 100-percent of the total installed duct area. Sections shall be selected by the building owner or the Architect and shall include sections of ductwork upstream and downstream of terminal units. Positive pressure leakage testing may be utilized for negative pressure ductwork.
- 9. Area requirement of 40-percent of the total installed duct area is inclusive of ductwork located in shafts or outside building envelope.
- C. Test ductwork prior to connection to fan equipment. Repair leaks and retest until stipulated results are achieved. Pressure testing to meet the following leakage classifications below as a minimum (2012 SMACNA HVAC Air Duct Leakage Manual, Table 4-1):
 - 1. Leakage class to be as defined below as a minimum.
 - a. Minimum Duct Leakage Classification

Duct Type	Leakage Class
Metal (Flexible excluded)	
Round and flat oval	3
Rectangular	6

- 2. Testing machine: Meet requirements of SMACNA standards. Pacific Air Products "Port-O-Lab", Rolok, or United Sheet Metal
- 3. Test supply systems prior to connecting terminal units.
- 4. Perform tests in presence of Owner's Authorized Representative. Give 48 hours advance notice before commencement of each test.
- 5. Test ductwork systems in sections as large as possible and record test results accordingly.
- 6. Leak test grease exhaust ductwork per requirements of latest edition of NFPA-96 and local Mechanical Code.
- 7. Coordinate testing with ceiling installation.
 - a. Provide sheet-metal plates and install between each duct test section (applies to main-to-main fittings, branch-to-branch fittings and main-to-branch fittings). At each plate location, fabricate joint with Ductmate. Insert 14 gauge sheet metal between Ductmate using a neoprene gasket on both sides of metal plate.
 - b. Leave plates in place until isolated section has been tested and approved by Owner's Authorized Representative.
 - c. Once sections have passed test, remove plates and reattach Ductmate joints. After fan unit is running, test joint for leakage by using a mixture of soap and water. If noise or bubbling occurs, reseal joint. Owner's Authorized Representative to witness this procedure.

8. Test duct at 1.5 times the design air pressure, up to pressure class of the duct. Seal audible leaks.

3.3 FUNDAMENTAL AIR SYSTEMS BALANCING PROCEDURES

- A. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- B. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- C. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- D. Prepare test reports for both fans and inlets and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.
- E. Prepare schematic diagrams of systems' "as-built" duct layouts.
- F. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- G. Check the airflow patterns from the outside-air louvers and dampers and the return-air and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- I. Verify that motor starters are equipped with thermal protection, sized for the connected load.
- J. Check dampers for proper position to achieve desired airflow path.
- K. Check for airflow blockages.
- L. Check that condensate drains are installed, trapped and primed and routed to drain.
- M. Check for readily observable leaks in air-handling unit components and ductwork.
- N. Use sheaves and pulleys to adjust the speed of belt drive fans to achieve design flow with motors running at 60 Hertz unless noted otherwise.

3.4 TEMPERATURE CONTROL VERIFICATION

- A. Examine automatic temperature system components to verify the following:
 1. Dampers, valves, and other controlled devices operate by the intended controller.
 2. Dampers and valves are in the position indicated by the controller.
 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, equipment, drafts, and cold walls.
 6. Sensors are located to sense only the intended conditions.
 7. Sequence of operation for control modes is according to the Contract Documents.
 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 9. Interlocked systems are operating.
 10. Changeover from heating to cooling mode occurs according to design values.

- B. Verify that controllers are calibrated and commissioned.
- C. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- D. Record controller settings and note variances between set points and actual measurements.
- E. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- F. Verify free travel and proper operation of control devices such as damper and valve operators.
- G. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- H. Confirm interaction of electrically operated switch transducers.
- I. Confirm interaction of interlock and lockout systems.
- J. Verify main control supply-air pressure and observe compressor and dryer operations.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.5 CONSTANT VOLUME AIR SYSTEMS BALANCING PROCEDURES

- A. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer. Adjust fans to deliver design airflow at the lowest possible speed.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each air-handling unit component under final balanced condition.
 - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Recommend corrective action to align design and actual conditions.
 - 4. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 5. Do not make fan-speed adjustments that result in motor loading greater than full load amps. Do not increase fan speed beyond fan class rating. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
 - 6. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
 - 7. Calibrate airflow measuring stations.

3.6 PRE-BALANCE REPORTING

- A. Pre-Construction Phase Report:
 - 1. Provide a pre-construction phase TAB Plan at least 2 weeks prior to the commencement of TAB work. This report is to include:

- a. A complete set of report forms intended for use on the Project, with all data filled in except for the field readings. Forms to be Project-specific.
 - b. Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
 - c. Identification of the type, manufacturer, and model of actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications are to be included.
 - d. A narrative of Project-specific and/or non-standard TAB procedures to be used, and the equipment or systems they apply to.
- B. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- C. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced.

3.7 FINAL REPORTS

- A. Report Requirements:
1. General:
 - a. Computer generated in PDF format and tabulated, divided, and bookmarked into sections by tested and balanced systems.
 - b. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.
 - 1) Include a list of the instruments used for procedures, along with proof of calibration.
 - c. Final Report Contents: In addition to the certified field report data, include the following:
 - 1) Pump curves
 - 2) Fan Curves
 - 3) Manufacturers Test Data
 - 4) Field test reports prepared by system and equipment installers
 - 5) Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data
- B. General Report Data:
1. In addition to the form titles and entries, include the following data in the final report, as applicable:
 - a. Title Page
 - b. Name and Address of TAB Agent
 - c. Project Name
 - d. Project Location
 - e. Architect's Name and Address
 - f. Engineer's Name and Address
 - g. Contractor's Name and Address

- h. Report Date
 - i. Signature of TAB Agent who Certifies the Report
 - j. Summary of Contents, Including the Following:
 - 1) Design versus Final Performance
 - 2) Notable Characteristics of Systems
 - 3) Description of System Operation Sequence if it varies from the Contract Documents
 - k. Nomenclature Sheets for Each Item of Equipment
 - l. Data for Terminal Units, including Manufacturer, Type Size, and Fittings
 - m. Notes to explain why certain final data in the body of reports vary from design values.
 - n. Test Conditions for Fans and Pump Performance Forms, Including the Following:
 - 1) Settings for Outside-, Return-, and Exhaust-air Dampers
 - 2) Conditions of Filters
 - 3) Cooling Coil, Wet- and Dry-bulb Conditions
 - 4) Face and Bypass Damper Settings at Coils
 - 5) Fan Drive Settings, including Settings and Percentage of Maximum Pitch Diameter
 - 6) Inlet Vane Settings for Variable-Air-Volume Systems
 - 7) Settings for Supply-air, Static-pressure Controller
 - 8) Other System Operating Conditions that affect Performance
- C. System Diagrams:
- 1. Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
 - a. Quantities of Outside, Supply, Return, and Exhaust Airflows
 - b. Water and Steam Flow Rates
 - c. Duct, Outlet, and Inlet Sizes
 - d. Pipe and Valve Sizes and Locations
 - e. Terminal Units
 - f. Balancing Stations
- D. Air Handling Units:
- 1. For air-handling units, split systems, fan coils, pumps, and evaporator units with coils, include the following:
 - a. Unit Data: Include the following:
 - 1) Unit Identification
 - 2) Location
 - 3) Make and Type
 - 4) Model Number and Unit Size
 - 5) Manufacturer's Serial Number
 - 6) Unit Arrangement and Class
 - 7) Discharge Arrangement
 - 8) Sheave Make, Size in inches, and Bore
 - 9) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - 10) Number of Belts, Make, and Size
 - 11) Number of Filters, Type, and Size
 - b. Motor Data: Include the following:

- 1) Make and Frame Type and Size
 - 2) Horsepower and rpm
 - 3) Volts, Phase, and Hertz
 - 4) Full-load Amperage and Service Factor
 - 5) Sheave Make, Size in Inches, and Bore
 - 6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
- c. Test Data: Include design and actual values for the following:
- 1) Total Airflow Rate in cfm (L/s)
 - 2) Total System Static Pressure in Inches wg (Pa)
 - 3) Fan rpm
 - 4) Discharge Static Pressure in Inches wg (Pa)
 - 5) Filter Static-pressure Differential in Inches wg (Pa)
 - 6) Preheat Coil Static-pressure Differential in Inches wg (Pa)
 - 7) Cooling Coil Static-pressure Differential in Inches wg (Pa)
 - 8) Heating Coil Static-pressure Differential in Inches wg (Pa)
 - 9) Outside Airflow in cfm (L/s)
 - 10) Return Airflow in cfm (L/s)
 - 11) Outside-air Damper Position
 - 12) Return-air Damper Position
 - 13) Vortex Damper Position
- E. Fans:
1. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - a. Fan Data: Include the following:
 - 1) System Identification
 - 2) Location
 - 3) Make and Type
 - 4) Model Number and Size
 - 5) Manufacturer's Serial Number
 - 6) Arrangement and Class
 - 7) Sheave Make, Size in Inches, and Bore
 - 8) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - b. Motor Data: Include the following:
 - 1) Make and Frame Type and Size
 - 2) Horsepower and rpm
 - 3) Volts, Phase, and Hertz
 - 4) Full-load Amperage and Service Factor
 - 5) Sheave Make, Size in Inches, and Bore
 - 6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - 7) Number of Belts, Make, and Size
 - c. Test Data: Include design and actual values for the following:
 - 1) Total Airflow Rate in cfm
 - 2) Total System Static Pressure in Inches wg
 - 3) Fan rpm
 - 4) Discharge Static Pressure in Inches wg
 - 5) Suction Static Pressure in Inches wg
- F. Duct Traverses:

1. Include a diagram with a grid representing the duct cross-section and record the following:
 - a. Report Data: Include the following:
 - 1) System and Air-handling Unit Number
 - 2) Location and Zone
 - 3) Duct Static Pressure in Inches wg
 - 4) Duct Size in Inches
 - 5) Duct Area in SF
 - 6) Design Airflow Rate in cfm
 - 7) Design Velocity in fpm
 - 8) Actual Airflow Rate in cfm
 - 9) Actual Average Velocity in fpm

G. Diffusers/Registers/Grilles:

1. For diffusers, registers and grilles, include the following:
 - a. Unit Data: Include the following:
 - 1) System and Air-handling Unit Identification
 - 2) Location and Zone
 - 3) Test Apparatus Used
 - 4) Area Served
 - 5) Air-terminal-device Make
 - 6) Air-terminal-device Number from System Diagram
 - 7) Air-terminal-device Type and Model Number
 - 8) Air-terminal-device Size
 - 9) Air-terminal-device Effective Area in SF
 - b. Test Data: Include design and actual values for the following:
 - 1) Airflow Rate in cfm
 - 2) Air Velocity in fpm
 - 3) Final Airflow Rate in cfm
 - 4) Final Velocity in fpm
 - 5) Space Temperature in Degrees F

H. Instrument Calibration:

1. For instrument calibration, include the following:
 - a. Report Data: Include the following:
 - 1) Instrument Type and Make
 - 2) Serial Number
 - 3) Application
 - 4) Dates of Use
 - b. Dates of Calibration

3.8 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 230700 - HVAC INSULATION**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Type A, Flexible Glass Wool Blanket
 - 2. Type B, Duct Liner
 - 3. Type C, Rigid Glass Wool Board
 - 4. Type D, Flexible Elastomeric Duct Insulation
 - 5. Type F, Closed-Cell Polyisocyanurate Rigid Foam Board
 - 6. Type 2, Flexible Elastomeric Pipe Insulation
 - 7. Jacketing
 - 8. Accessories
 - 9. Duct Insulation Accessories
 - 10. Duct Insulation Compounds

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Installer qualifications.
 - 2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any) for each type of product indicated.
 - 3. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
 - 4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
 - 5. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.

2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
4. Installer to have minimum 5 years' experience in the business of installing insulation.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with the requirements of current edition of UL "Pipe and Equipment Coverings R5583 400 8.15".
- C. Test duct insulation in accordance with current edition of ASTM E84, UL 723, NFPA 255, NFPA 90A and NFPA 90B.

PART 2 - PRODUCTS

2.1 TYPE A, FLEXIBLE GLASS WOOL BLANKET

- A. Acceptable Manufacturers:
 1. Certainteed
 2. Johns Manville
 3. Knauf
 4. Owens-Corning
- B. ASTM C553, Type 1, Class B-2; flexible blanket.
- C. 'K' Value: 0.27 BTU*in/(hr*sf°F) at 75 degrees F installed, maximum service temperature: 250 degrees F.
- D. Density: 0.75 pounds per cubic foot.
- E. DBDE-free. UL/E validated to be formaldehyde-free.
- F. Vapor Barrier Jacket: FSK aluminum foil reinforced with glass wool yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed.

2.2 TYPE B, DUCT LINER

- A. Acceptable Manufacturers:
 1. Certainteed
 2. Johns Manville
 3. Knauf
 4. Owens-Corning
- B. ASTM C1071; flexible blanket.
- C. 'K' Value: ASTM C518, 0.25 BTU*in/(hr*sf°F) at 75 degrees F, maximum service temperature: 250 degrees F.

- D. Noise Reduction Coefficient: 0.65 or higher based on ASTM C 423 "Type A mounting."
- E. Maximum Velocity on Mat or Coated Air Side: 5,000 FPM.
- F. Adhesive: UL listed waterproof type.
- G. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
- H. Erosion-Resistant Surfaces: UL 181.
- I. ASTM G21 and ASTM G22 Microbial Growth Resistance.
- J. UL GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C 1338 and meets UL Environment GREENGUARD Microbial Resistance Listing per UL 2824-"GREENGUARD Certification Program Method for Measuring Microbial Resistance". DBDE-free. UL/E validated to be formaldehyde-free.

2.3 TYPE C, RIGID GLASS WOOL BOARD

- A. Acceptable Manufacturers:
 - 1. Certainteed
 - 2. Johns Manville
 - 3. Knauf
 - 4. Owens-Corning
- B. ASTM C612; rigid board.
- C. 'K' Value: 0.23 BTU*in/(hr*sf°F) at 75 degrees F.
- D. Density: 3.0 pounds per cubic foot.
- E. Vapor Retardant Jacket: AP, bleached Kraft paper bonded to aluminum foil, reinforced with glass wool yarn; or FSK aluminum foil reinforced with glass wool yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed.

2.4 TYPE D, FLEXIBLE ELASTOMERIC DUCT INSULATION

- A. Acceptable Manufacturers:
 - 1. Armacell LLC Armaflex
 - 2. Or approved equivalent.
- B. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 - 1. Thermal Conductivity Value: 0.28 BTU*in/(hr*sf°F) at 75 degrees F.
 - 2. Maximum Service Temperature of 220 degrees F.
 - 3. Maximum Flame Spread: 25.
 - 4. Maximum Smoke Developed: 50 (1-inch thick and below).
 - 5. Connection: Waterproof vapor retarder adhesive as needed.
 - 6. UV Protection: UV outdoor protective coating as needed per manufacturer's requirements.
 - 7. Vapor Barrier Jacket for use in ceiling return air plenums: FSK aluminum foil reinforced with glass wool yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed.
- C. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.

- D. Paint: Nonhardening high elasticity type, manufactured as protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.

2.5 TYPE F, CLOSED-CELL POLYISOCYANURATE RIGID FOAM BOARD

- A. Acceptable Manufacturers:
 - 1. Johns Manville
 - 2. Certainteed
 - 3. Knauf
 - 4. RMax
- B. ASTM C1289, Type 1, Class 1.
- C. Thermal Conductivity: 0.16 BTU*in/(hr*sf*F).
- D. Service Temperature: -100 degrees F to 250 degrees F.
- E. Jacketing: 0.024-inch thick multi-layered laminate with tensile strength of 187 lb/inch, puncture resistance of 68 pounds per ASTM D1000, emittance of 0.03 per ASTM C1371, WVTR of 0.00 perm per ASTM E96, and service temperature of -94 degrees F to 248 degrees F, as manufactured by 3M, VentureClad1579GCW-E, or approved equivalent.

2.6 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

- A. Acceptable Manufacturers:
 - 1. Insulation:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
 - 2. Glue:
 - a. Armacell LLC Armaflex Low VOC Adhesive
 - b. K-Flex
 - c. Or approved equivalent.
 - 3. Paint:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
- B. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 - 1. Thermal Conductivity Value: As indicated in the insulation tables below.
 - 2. Maximum Service Temperature of 220 degrees F.
 - 3. Maximum Flame Spread: 25.
 - 4. Maximum Smoke Developed: 50 (1-inch thick and below).
 - 5. Vapor Retarder Jacket, for over 1-inch insulation thickness: White Kraft paper reinforced with glass wool and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or vapor barrier mastic.
 - 6. Connection: Waterproof vapor retarder adhesive as needed.
 - 7. UV Protection: UV outdoor protective coating per manufacturer's requirements.
- C. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.

- D. Paint (for exterior insulation only): Nonhardening high elasticity type, specifically manufactured as protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.

2.7 JACKETING

- A. Acceptable Manufacturers:
 - 1. ITW Insulation Systems
 - 2. General Insulation Company
 - 3. 3M
 - 4. Or approved equivalent.
- B. Insulation Jacketing and Insulation Jacketing Tape for Ductwork and Piping: 0.024-inch thick multi-layered laminate with tensile strength of 187 lb/inch, puncture resistance of 68 pounds per ASTM D1000, emittance of 0.03 per ASTM C1371, WVTR of 0.00 perm per ASTM E96, and service temperature of -94 degrees F to 248 degrees F, as manufactured by 3M, VentureClad1579GCW-E, or approved equivalent.
- C. PVC preformed molded insulation covers, for piping. Zeston or approved equivalent.
- D. Stainless Steel Jacket: Type 304 stainless steel, 0.010-inch, smooth finish.

2.8 ACCESSORIES

- A. Acceptable Manufacturers:
 - 1. ITW Insulation Systems
 - 2. Or approved equivalent.
- B. Equipment Insulation Jacketing: Presized glass cloth, not less than 7.8 ounces/sq.yd., except as otherwise indicated. Coat with gypsum based cement.
- C. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- D. General: Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have the same flame and smoke component ratings as the insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water-soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.9 DUCT INSULATION ACCESSORIES

- A. Acceptable Manufacturers:
 - 1. Certainteed
 - 2. Johns Manville
 - 3. Owens-Corning
- B. Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

2.10 DUCT INSULATION COMPOUNDS

- A. Acceptable Manufacturers:
 - 1. Certainteed

2. Johns Manville
 3. Owens-Corning
- B. Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation manufacturer for applications indicated. Comply with South Coast Air Quality Management District (SCAQMD) Rule #1168 in accordance with LLE EQ 4.1.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Verification of Conditions:
1. Do not apply insulation until pressure testing and inspection of ducts and piping has been completed.
 2. Examine areas and conditions under which duct and pipe insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Preparation: Clean and dry surfaces to be insulated.
- C. Installation:
1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.
 2. Piping and Equipment:
 - a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.
 - b. Cover insulation on pipes above ground, outside of building, with aluminum jacketing. Position seam on bottom of pipe.
- D. Cover insulation on exposed refrigerant piping above ground, outside of building with heavy duty multi-layered laminated jacketing tape. Position seams on bottom of pipe. Use Venture Tape VentureClad Plus 1579GCW-E or approved equal.
- E. Provide accessories as required. See Part 2 Article "Accessories" above.
- F. Protection and Replacement: Installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- G. Labeling and Marking: Provide labels, arrows and color on piping and ductwork. Attach labels and flow direction arrows to the jacketing per Section 23 05 53, Identification for HVAC Piping, Ductwork and Equipment.
- H. Ductwork:
1. Install insulation in conformance with manufacturer's recommendations to completely cover duct.
 2. Butt insulation joints firmly together and install jackets and tapes smoothly and securely.
 3. Apply duct insulation continuously through sleeves and prepared openings, except as otherwise specified. Apply vapor barrier materials to form complete unbroken vapor seal over insulation.

4. Coat staples and seals with vapor barrier coating.
 5. Cover breaks in jacket materials with patches of same material as vapor barrier. Extend patches not less than 3-inches beyond break or penetration on all directions and secure with adhesive and staples. Seal staples and joints with vapor barrier coating.
 6. Fill jacket penetrations. i.e., hangers, thermometers and damper operating rods, and other voids in insulation with vapor barrier coating. Seal penetration with vapor barrier coating. Insulate hangers and supports for cold duct in un-conditioned spaces to extent to prevent condensation on surfaces.
 7. Seal and flash insulation terminations and pin punctures with reinforced vapor barrier coating.
 8. Continue insulation at fire dampers and fire/smoke dampers up to and including those portions of damper frame visible at outside of the rated fire barrier. Insulating terminations at fire dampers in accordance with this Section.
 9. Do not conceal duct access doors with insulation. Install insulation terminations at access door in accordance with this Section.
- I. Insulated Pipe Exposed to Weather: Where piping is exposed to weather, cover insulation with aluminum jacket. Seal watertight jacket per manufacturer's recommendations. Install metal jacket with 2-inch overlap at longitudinal and butt joints with exposed lap pointing down. Secure jacket with stainless-steel draw bands 12-inches on center and at butt joints.
- J. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 2-inches and larger (hot and cold) piping.
- K. Ductwork Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Duct Size	Insulation Thickness
Supply ductwork where duct is not specified to be lined.	A	All	1.5-inch
Return ductwork where duct is not specified to be lined.	--	All	None
Supply ductwork (located outside building thermal envelope)	A (for round ductwork) F (for rectangular ductwork)	All	3-inch (for round ductwork) 1.5-inch (for rectangular ductwork)
Return ductwork (located outside building thermal envelope)	A (for round ductwork) F (for rectangular ductwork)	All	3-inch (for round ductwork) 1.5-inch (for rectangular ductwork)
Outside Air Ducts	A	All	3-inch
HVAC plenums and unit housings not preinsulated	B	All	1.5-inch

Exhaust ducts within 10-feet of exterior	A	All	3-inch
Exposed insulation in mechanical rooms or areas subject to damage	C, D	All	1.5-inch

1. Note: Insulation thickness shown is a minimum. If state codes require additional thickness, then provide insulation thickness per code requirements.

L. Piping Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Conductivity Range (Btu-inch per hour per SF per degrees F)	Pipe Size (Inches)	Insulation Thickness (Inches)
Refrigerant Suction and Liquid Piping (40F to 60F)	2	0.21-0.27 at a mean rating temperature of 75 degrees F	<1	0.5
			1 to <1.5	0.5
			1.5 to <4	1.0
			4 to <8	1.0
			>= 8	1.0
Refrigerant Suction and Liquid Piping (<=40F)	2	0.20-0.26 at a mean rating temperature of 50 degrees F	<1	0.5
			1 to <1.5	1.0
			1.5 to <4	1.0
			4 to <8	1.0
			>= 8	1.5
Refrigerant Hot Gas Piping for VRF Systems	2	0.20-0.26 at a mean rating temperature of 50 degrees F	All	0.5

1. Note: Insulation thickness shown is a minimum. If state code requires additional thickness, then provide insulation thickness per code requirements.

3.2 TYPE A, FLEXIBLE GLASS WOOL BLANKET

- A. Install insulation in conformance with manufacturer's recommendations and requirements.

- B. Duct Wrap: Cover air ducts per insulation table except ducts internally lined where internal duct lining is adequate to achieve adequate insulating values to meet local Energy Codes (indicate on shop drawings, locations where duct wrap is planned to be omitted and indicate internal duct lining insulating values to confirm they will meet the Energy Code.) Wrap tightly with circumferential joints butted and longitudinal joints overlapped minimum of 2-inches. On ducts over 24-inches wide, additionally secure insulation with suitable mechanical fasteners at 18-inches on center. Circumferential and longitudinal joints stapled with flare staples 6-inches on center and covered with 3-inch wide, foil reinforced tape.

3.3 TYPE B, DUCT LINER

- A. Install insulation in conformance with manufacturer's recommendations and requirements.
- B. Duct Liners: Mat finish surface on air stream side. Secure insulation to cleaned sheet metal duct with continuous (minimum 90) percent coat of adhesive. Secure liner with mechanical fasteners 15-inches on center or per manufacturer requirements. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom sections of insulation overlap sides. Factory/field coat exposed edges. Metal nosing for exposed leading or transverse edges and when velocity exceeds 3500 FPM or manufacturer rating on exposed edges. Keep duct liner clean and free from dust. At completion of Project, vacuum duct liner if it is dirty or dusty. Do not use small pieces. If insulation is installed without horizontal, longitudinal, and end joints butted together, installation will be rejected and work removed and replaced with work that conforms to this Specification.

3.4 TYPE C, RIGID GLASS WOOL BOARD

- A. Install insulation in conformance with manufacturer's recommendations and requirements.

3.5 TYPE D, FLEXIBLE ELASTOMERIC DUCT INSULATION

- A. Install insulation in conformance with manufacturer's recommendations and requirements.

3.6 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

- A. Flexible Elastomeric Insulation:
 - 1. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and below grade with two coats of finish as recommended by manufacturer.
- B. Flexible Elastomeric Tubing:
 - 1. Flexible Elastomeric Tubing: Slip insulation over piping or, if piping is already installed, slit insulation and snap over piping. Joints and butt ends must be adhered with 520 adhesive.
- C. See General Installation Requirements above.
- D. Install insulation in conformance with manufacturer's recommendations and requirements.
- E. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.
- F. Install in accordance with manufacturer's instructions for below grade installation.

3.7 JACKETING

- A. See General Installation Requirements above.

B. Install in accordance with manufacturer's instructions.

3.8 ACCESSORIES

A. Install insulation in conformance with manufacturer's instructions, recommendations and requirements.

B. See General Installation Requirements above.

C. Furnish and install accessories for all insulation types listed in this Section.

3.9 DUCT INSULATION ACCESSORIES

A. Install insulation in conformance with manufacturer's recommendations and requirements.

3.10 DUCT INSULATION COMPOUNDS

A. Install insulation in conformance with manufacturer's recommendations and requirements.

END OF SECTION

SECTION 232113 - HVAC PIPING**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
1. Equipment Drains and Overflows
 2. Unions
 3. Refrigerant Piping

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
1. Welding Certificates: Copies of certificates for welding procedures and personnel.
 2. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Failed test results and corrective action taken to achieve requirements.
 3. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at project site.
 4. Grooved couplings, fittings, valves, and specialties: Show grooved joint couplings and fittings on Shop Drawings and product submittals, and specifically identify with the applicable coupling style number.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
1. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with documented experience.
 2. Welder Qualifications: Certify in accordance with ASME (BPV IX).
 3. ASME Compliance: Comply with ASME B31.9 "Building Services Piping" for materials, products, and installation. Provide safety valves and pressure vessels with the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 01.
 4. Grooved couplings, fittings, valves, and specialties: Provide all grooved couplings, fittings, valves, and specialty products from a single manufacturer. Utilize only grooving tools from the same manufacturer as the grooved components. Date-stamp all castings

used for couplings housings, fittings, or valve and specialty bodies for quality assurance and traceability.

5. Refrigerant Piping:
 - a. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX "Welding and Brazing Qualifications."
 - b. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
 - c. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."
 - d. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical" or UL 429 "Electrically Operated Valves."

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn.
 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 2. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.
 3. Joints: Brazed, AWS A5.8, Classification BAg-1 (silver). Pipes 2-1/2-inch or larger or piping routed over food preparation centers, food serving facilities, food storage areas, computer rooms, telecommunications rooms, and electrical rooms.

2.2 UNIONS

- A. Unions for Pipe 2-inches and Under:
 1. Ferrous Piping: 150, 250, and 300 PSIG malleable iron, threaded, ASME B16.39.
 2. Copper Pipe: Bronze, soldered joints, ASME B16.22.
- B. Dielectric Connections: Provide dielectric waterway or brass nipple fitting with threaded ends. Dielectric unions are not allowed.

2.3 REFRIGERANT PIPING

- A. Piping:
 1. Copper Tube: ASTM B 280, Type ACR, annealed-temper tube, clean, dry and capped.
 - a. Fittings: ASME B16.22 wrought copper.
 - b. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy (15 percent Silver).
- B. Valves:
 1. Manufacturers:
 - a. Hansen Technologies Corporation
 - b. Henry Technologies
 - c. Danfoss Flomatic
 - d. Substitutions: See Section 23 00 00, HVAC Basic Requirements, Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 2. Packaged Ball Valves:

- a. Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of and maximum temperature of 300 degrees F.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install per manufacturer's written instructions and requirements.
- B. Above Grade Piping Installation:
 1. Install per manufacturer's written instructions and requirements.
 2. Install heating water, glycol, condenser water, piping to ASME B31.9 requirements. Install chilled water piping to ASME B31.5 requirements.
 3. Route piping in orderly manner, parallel to building structure, and maintain gradient.
 4. Install piping to conserve building space and to avoid interference with use of space.
 5. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
 6. Sleeve pipe passing through partitions, walls and floors allowing adequate space for pipe insulation.
 7. Slope piping at 0.2 percent upward in direction of flow and arrange to drain at low points.
 8. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
 9. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
 10. Drawings are diagrammatic and do not necessarily show top connections in all cases. Install branch connections to mains using tee fittings in main, with takeoff coming out of the top unless trade coordination conditions preclude it.
 11. Anchor piping for proper direction of expansion and contraction.
 12. Inserts:
 - a. Provide inserts for placement in concrete formwork.
 - 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 over 4-inches.
 - 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.
 13. Pipe Hangers and Supports:
 - a. Install in accordance with Division 23, HVAC, Hangers and Supports.
 - b. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
 - c. Place hangers within 12-inches of each horizontal elbow.
 - d. Use hangers with 1-1/2-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - e. Support vertical piping at top, bottom, and not less than every other floor. Support riser piping independently of connected horizontal piping.

- f. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - g. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
 - h. Provide copper plated hangers and supports for copper piping.
 - i. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
14. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
 15. Provide access where valves and fittings are not exposed.
 16. Use eccentric reducers to maintain top of pipe level.
 17. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
 18. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.
- C. Field Quality Control:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush system with clean water. Clean strainers.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, provide closure capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
 6. Perform the following tests on hydronic piping:
 - a. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - b. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
 - c. Check expansion tanks to determine that they are not air bound and that system is full of water.
 - d. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure not-to-exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
 - e. After hydrostatic test pressure has been applied for at least four hours, examine piping, joints and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - f. Prepare written report of testing.
- D. Flushing and Cleaning of Piping Systems:
1. Clean piping systems thoroughly. Purge pipe of construction debris and contamination before placing the piping systems in service. Provide temporary connections for cleaning, purging, and circulating fluids through the piping system.

2. Use temporary strainers and temporary pumps that can create fluid velocities up to 10 feet per second to flush and clean the piping systems. Do not use Owner's permanent strainers to trap debris during pipe flushing operations. Fit the temporary construction strainers with a line size blowoff valve.
3. When constructing minor piping modifications or additions, verify with Owner if the Owner's pumps and strainers can be used for flushing and chemical cleaning operations. When the flushing and cleaning operations are complete, ensure the strainer baskets and screens installed in the piping systems permanent strainers are replaced with clean elements. Keep temporary strainers in service until the equipment has been tested, then replace straining element with a new strainer and clean and deliver the old straining elements to Owner. Fit the Owner's strainers with a line size blowoff valve.
4. Install bypass piping or hoses at the supply and return piping connections at heat exchangers, chillers, cooling towers, pumps, and cooling coils, etc., to prevent debris from being caught or causing damage to equipment which will be connected to the piping system.
5. Circulate a chemical cleaner in chilled and heating water piping systems to remove mill scale, grease, oil, and silt. Cleaner to be selected by chemical treatment vendor on project. Circulate for 48 hours, flush system and replace with clean water. Dispose of chemical solution in accordance with local codes. The chilled and heating water system should then be treated with chemicals and inhibitors to be selected by chemical treatment vendor on project. When the chemical cleaning is complete, remove, clean, and reinstall all permanent screens. Notify Owner so that the reinstallation of clean strainer screens may be witnessed.

E. Pipe Painting Requirements:

1. Paint all ferrous metal pipe including flanges. Do not paint flange bolts, washers and nuts. At flexible coupling the only the flanges are to be painted. All rubber portions are to remain unpainted.
2. Paint exterior uninsulated steel piping with exterior latex, semi-gloss (AE), Master Painters Institute MPI 11, suitable for metallic surfaces B, Haze Gray color.
3. Use ready-mixed (including colors) paint. Prime paint with pigment and vehicle, compatible with substrate and finish coats specified. Volatile Organic Compounds (VOC) content of paint materials shall not exceed 50g/l for exterior latex paints and primers. Lead-based paint is not permitted.
4. Do not apply coating when air or substrate conditions are:
 - a. Less than 5 degrees F above dew point.
 - b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the product manufacturer.
5. Do no exterior painting when it is windy and dusty. Do not paint in direct sunlight or on surfaces that the sun will soon warm.
6. Apply only on clean, dry and frost-free surface. Remove all materials the will affect the ability of the paint to adhere to the pipe including painted pipe identification labels.
7. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign. Remove loose mill scale, rust, and paint, by hand or power tool cleaning. All surfaces are to be dry at the time paint is applied.
8. Apply paint in two coats; prime, and finish. Apply each coat evenly and cover substrate completely. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions.

9. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects. Apply by brush, roller or spray.

3.2 REFRIGERANT PIPING INSTALLATION

- A. Install systems in accordance with ASHRAE Standard 15.
- B. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- C. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- D. Flood piping system with nitrogen when brazing.
- E. Follow ASHRAE Standard 15 procedures for charging and purging of systems and for disposal of refrigerant.
- F. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- G. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- H. Fully charge completed system with refrigerant after testing.
- I. Field Quality Control:
 1. Test refrigeration system in accordance with ASME B31.5.
 2. Pressure test system with dry nitrogen to 200 PSI. Perform final tests at 27-inches vacuum and 200 PSI using electronic leak detector. Test to no leakage.

END OF SECTION

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Ductwork, Joints and Fittings
 - 2. Insulated Flexible Duct
 - 3. Drain Pans
 - 4. Ductwork Joint Sealers and Sealants

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 23 05 29, Hangers and Supports for HVAC Piping, Ductwork and Equipment.
 - 2. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Welding Certificates
 - 2. Field Quality Control Reports

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NFPA Compliance:
 - a. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
 - b. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
 - 2. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Provide sheet metal materials free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Duct design is generally diagrammatic and is not meant to be scaled. Major changes to layout or configuration of duct

system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

PART 2 - PRODUCTS

2.1 DUCTWORK, JOINTS AND FITTINGS

- A. Manufacturers:
 - 1. Ductmate
 - 2. Lindab Inc.
 - 3. Nexus Inc.
 - 4. SEMCO
 - 5. United McGill Corporation
 - 6. Ward Industries
- B. Materials:
 - 1. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, lock-forming quality, ASTM A 653/A 653M FS Type B, with G90/Z275 coating. Ducts to have mill phosphatized finish for surfaces exposed to view.
 - 2. Aluminum Ducts: ASTM B 209 (ASTM B 209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts with liquid-tight joints when containing condensate vapor or liquids in suspension.
 - 3. Stainless Steel: Fabricated in accordance with ASTM A167 and A480 with liquid-tight joints when containing condensate vapor or liquids in suspension.
- C. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems not-to-exceed deflection limits according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
 - 3. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
- D. Formed-On Flanges: construct according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Figure 1-4, using corner, bolt, cleat, and gasket details.
 - 1. Duct Size: Maximum 30-inches wide and up to 2-inch wg pressure class.
 - 2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
 - 3. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19-inches and larger and 0.0359-inch thick or less, with more than 10 SF of nonbraced panel area unless ducts are lined.
- E. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of material specified in this Section according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
 - 1. Ducts up to 20-inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.

2. Ducts 21- to 72-inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 3. Ducts Larger than 72-inches in Diameter: Companion angle flanged joints per SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-2.
 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
- F. 90-Degree Tees and laterals and Conical Tees: Fabricate to comply with SMACNA's HVAC Duct Construction Standards-Metal and Flexible, with metal thicknesses specified for longitudinal-seam straight ducts.
- G. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- H. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows to be 1.5 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's HVAC Duct Construction Standards-Metal and flexible, unless otherwise indicated.
 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
 - a. Ducts 3- to 36-inches in Diameter: 0.034-inch .
 - b. Ducts 37- to 50-inches in Diameter: 0.040-inch.
 - c. Ducts 52- to 60-inches in Diameter: 0.052-inch.
 - d. Ducts 62- to 84-inches in Diameter: 0.064-inch.
 3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
 - a. Ducts 3- to 26-inches in Diameter: 0.034-inch.
 - b. Ducts 27- to 50-inches in Diameter: 0.040-inch.
 - c. Ducts 52- to 60-inches in Diameter: 0.052-inch.
 - d. Ducts 62- to 84-inches in Diameter: 0.064-inch.
 4. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 5. Round Elbows:
 - a. 8-inches and Less in Diameter: Fabricate die-formed elbows for 45 and 90-degree elbows and pleated elbows for 30, 45, 60 and 90 degrees only. Fabricate nonstandard bend-angle configurations or non-standard diameter elbows with gored construction.
 - b. 9 through 14-inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60 and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - c. Larger than 14-inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 6. Die-Formed Elbows for Sizes through 8-inches in Diameter and Pressures 0.040-inch thick with two-piece welded construction.

7. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
8. Pleated Elbows for Sizes through 14-inches in Diameter and Pressures through 10-inch wg (2500 Pa): 0.022-inch.
9. Not acceptable:
 - a. Corrugated or flexible metal duct.
 - b. Adjustable elbows.

2.2 INSULATED FLEXIBLE DUCT

- A. Manufacturers:
 1. ATCO
 2. Flexmaster
 3. J.P. Lamborn Co.
 4. Hart and Cooley
- B. Construction: Standard factory fabricated product. Inner wall: Impervious vinyl or chlorinated polyethylene, permanently bonded to a vinyl or zinc-coated spring steel helix.
- C. Insulation: Fiberglass blanket insulation covered by an outer wall of vinyl or fiberglass-reinforced metalized vapor barrier.
- D. Listing: UL 181 listed Class 1 flexible air duct material. Overall thermal transmission: No more than 0.25 BTU/in or hr/sq. degrees F at 75 degrees F differential, per ASTM C335.
- E. Vapor transmission value no more than 0.10 perm, per ASTM E96.
- F. Pressure Rating: 4-inch wg positive pressure and 1-inch wg negative pressure.
- G. Performance Air Friction Correction Factor: 1.3 maximum at 95 percent extension. Working air velocity: Minimum 2000 FPM.
- H. Flame Spread Rating: No more than 25.
- I. Smoke Development Rating: No more than 50 as tested per ASTM E84.
- J. Insertion Loss: Minimum attenuation of 29 DB for 10-foot straight length at 8-inch diameter at 500 Hz.

2.3 DRAIN PANS

- A. Primary Drain Pans: Stainless Steel, Fabricated in accordance with ASTM A167 and A480.
- B. Secondary Drain Pans: Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M FS Type B, with G90/Z275 coating.

2.4 DUCTWORK JOINT SEALERS AND SEALANTS

- A. Manufacturers:
 1. Ductmate
 2. Duro Dyne
 3. Harcast
 4. United McGill Corporation
 5. Vulkem
 6. Foster
 7. Childer
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

- C. Low Emitting Materials Requirement: Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
- D. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure and leakage class of ducts.
- E. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.
- F. Water Based Sealant for Brush-On Application: Flexible, adhesive sealant, resistant to UV light, UL-181A, and UL-181-B listed, complying with NFPA requirements for Class 1 ducts. Min. 69 percent solids, nonflammable. Hardcast Versa-Grip 181; Childers CP-146; Foster 32-19 for SMACNA 1/2, 1, 2, 3, 4, 6, and 10-inch WG duct classes, and SMACNA Seal Class A, B, or C.
- G. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
- H. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.
- I. Polyurethane Sealant: General-purpose, exterior use, non-brittle sealant for gunned application. Vulkem 616 or equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. General: Use the following pressure seal, and leakage class(es) in design of ductwork specified in this section unless otherwise noted on Drawings.

SYSTEM	PRESSURE CLASS (Inches of Water)	SEAL CLASS	LEAKAG E CLASS ROUND DUCTS	LEAKAGE CLASS RECTANGUL AR DUCTS
Low pressure (downstream of terminal unit)	+ 1-inch	A	3	6
Return and exhaust	0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.	A	3	6

- B. Ductwork Installation:
 1. General: Install entire duct system in accordance with drawings, Specifications, and latest issues of local Mechanical Code, NFPA 90A, and SMACNA Duct Construction Manual. At Contractor's option, rectangular ductwork may be resized to maintain an equivalent air velocity and friction rate, while maintaining a maximum aspect ratio of 3. Remove markings and tagging from ductwork exterior surface in mechanical rooms and other locations where ductwork is exposed.
 2. The duct layout shown on the Contract Drawings is diagrammatic in nature. Coordinate the ductwork routing and layout, and make alterations to the ductwork routing and layout

to eliminate physical interferences. Where deviations in the ductwork routing as shown in the Contract Drawings are required, alterations may be made so as not to compromise the air flow, pressure drop, and sound characteristics of the duct fitting or duct run as shown on the Contract Drawings. In the event Architect determines that the installed ductwork is inconsistent with the above mentioned criteria, remove and replace at no additional cost to the Owner.

3. Install ducts with fewest possible joints.
4. Install fabricated fittings for changes in directions, size, shape, and for connections.
5. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches, with a minimum of 3 screws in each coupling.
6. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
7. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
8. Install ducts with a clearance of 1-inch, plus allowance for insulation thickness. Allow for easy removal of ceiling tile.
9. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
10. Coordinate layout with suspended ceiling, air duct accessories, lighting layouts, and similar finish work.
11. Electrical and IT Equipment Spaces: route ducts to avoid passing through transformer vaults, electrical equipment spaces, IDF/MPOE rooms, and enclosures.
12. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2-inches.
13. Fire- and Smoke-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire, smoke or combination fire and smoke dampers as governed by Building Code and AHJ, including sleeves, and firestopping sealant.
14. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's Duct Cleanliness for New Construction Advanced Level.
15. Paint interiors of metal ducts, that do not have duct liner, for 24-inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible duct material.
16. Install ductwork in the location and manner shown and detailed. Review deviations required by job conditions with Architect prior to any fabrication. Provide fittings for construction per SMACNA.
17. Install flexible ductwork to limit sag between support hangers to 1/2-inch per foot of spacing support.

C. Flanged Take-Offs:

1. Install at branch takeoffs to outlets using round or flex duct.
2. Flanged take-offs secured with minimum 8-inch screw spacing (three screws minimum).
3. Provide ductwork taps and branches off of main ducts at 45 degrees whether shown on Drawings or not (drawings are diagrammatic).

D. Cleaning:

1. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.
2. Grille and Exposed Duct Cleaning:
 - a. After completion of ductwork installation, operate each fan system (excluding exhaust fans) for a minimum of 30 minutes prior to installation of ceiling grilles and diffusers. After grilles and diffusers are installed, clean out accumulation of particles from grilles and diffusers prior to acceptance.
 - b. Clean exterior surface of ducts exposed to public view of chalk, pencil and pen marks, labels, sizing tags, dirt, dust, etc., so that upon completion of installation, ducts are left in clean and unblemished manufactured conditions.
 - c. Exposed duct and grilles to remain free of dust entrained streaks due to leakage at joints and grille connections during warranty period. Clean leaks, seal and refinish to match existing if visible streaks develop.

3.2 DUCTWORK, JOINTS AND FITTINGS INSTALLATION

A. Duct Materials - Applied Locations:

1. General: Use the following materials in design of ductwork specified in this Section unless otherwise noted on the Drawings.

Location or Application	Material
Supply, Return, Transfer, and Exhaust - Low Pressure	Single Wall, Galvanized Steel

B. Ductwork Installation:

1. Fabricate radius elbows with centerline radius not less than 1-1/2 duct diameters.
2. Do not install duct size transition pitch angles which exceed 30 degrees for reductions in duct size in the direction of airflow, and 15 degrees for expansions in duct size in the direction of airflow.
3. Install fixed turning vanes in square throat rectangular elbows and in tees.
4. Fabricate duct turns with the inside (smallest) radius at least equal to the duct width (supply ducts) and 1.5 times radius (return and exhaust ducts). Where necessary, square elbows may be used, with maximum available inside radius and with fixed turning vanes. In healthcare settings such as hospitals and medical office buildings, square elbows and turning vanes allowed on supply ductwork only.

3.3 INSULATED FLEXIBLE DUCT INSTALLATION

- A. Provide sheet metal plenum or rigid elbow and connect to diffusers and grilles with ductwork connections. Refer to Drawings for more information. Provide straight section of flexible duct with minimum length of 2-feet and maximum length of 5-feet and connect to sheet metal plenums and rigid elbows connected to diffusers and grilles, unless noted otherwise.
 1. Provide round neck grilles/diffusers or square-to-round transitions. Flexible duct connections directly to diffuser and grilles is not allowed.
 2. Flexible duct allowed in concealed spaces above lay-in ceilings only.

3.4 DRAIN PANS INSTALLATION

- A. Install where shown on Drawings. Drain provided by Division 22, Plumbing. Provide drain (sized per code) connection from each drain pan and pipe to nearest floor drain through trap

and 10-inch air gap. Drain pans over 6-feet in length require drain connections from both ends. Pitch drain pans in direction of air flow and to drain. Support secondary drain pan independently from equipment.

3.5 DUCTWORK JOINT SEALERS AND SEALANTS INSTALLATION

A. Joints and Seam Joint Sealing:

1. Seal duct seams and joints according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, for duct pressure class indicated.
2. Seal transverse joints, longitudinal seams and duct wall penetrations including screw, fastener, pipe, rod, and wire.
3. Seal ducts before external insulation is applied.
4. Fasteners such as sheet-metal screws, machine screws or rivets to be cadmium plated.
5. Rectangular Ductwork: Where intermediate joint reinforcement is required for duct of negative pressure class, pre-drill stiffening flange and provide fastener maximum 8-inches on center. Where retaining flanges are welded to duct wall, paint welds with zinc coating.
6. Single Wall Round Ductwork: Joint to incorporate beaded slip collar with minimum #8 sheet metal screws 8-inches on center. Seal ductwork as specified in this Section.
7. Seal joints and seams. Apply sealant to make end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
8. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
9. Provide openings in ductwork where required to accommodate thermometers and control devices. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
10. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities as well as Code required clearances.

END OF SECTION

SECTION 233300 - AIR DUCT ACCESSORIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Sheet Metal Materials
 - 2. Backdraft Dampers
 - 3. Dampers
 - 4. Concealed Damper Hardware
 - 5. Access Doors
 - 6. Duct Test Holes
 - 7. Dynamic Fire Dampers
 - 8. Static Fire Dampers
 - 9. Ceiling Fire Dampers
 - 10. Control Dampers
 - 11. Turning Vanes
 - 12. Flexible Connectors
 - 13. Air Flow Measuring Station (Hot Wire Anemometer Type)

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Manufacturer's catalog data and fabrication/installation drawings for each factory fabricated duct accessory. Include leakage, pressure drop and maximum back pressure data.
 - 2. Shop Drawings: Indicate air duct accessories.
 - 3. Manufacturer's installation instructions: Provide instructions for each factory fabricated duct accessory.
 - 4. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - a. See Division 01, General Requirements, Product Requirements for additional provisions.
 - b. Extra Fusible Links: One of each type and size.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum five years of documented experience.

2. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
3. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
4. AMCA 511 - Certified Ratings Program for Air Control Devices.
5. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
6. NFPA 101 - Life Safety Code.
7. UL 555 - Standard for Safety; Fire Dampers.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M. Galvanizing: 1-1/4 ounces per square foot total both sides; ducts to have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.

2.2 BACKDRAFT DAMPERS

- A. Manufacturers:
 1. Air Balance
 2. Cesco
 3. Greenheck
 4. Nailor
 5. Ruskin
- B. Basis-of-Design: Ruskin CB D6.
- C. Description: Multiple-blade gravity balanced with center pivoted blades with sealed edges, assembled in rattle free manner with 90-degree stop, adjustment device to permit setting for varying differential static pressure.
- D. Frame: 0.125-inch thick 6063-T5 extruded aluminum channel with galvanized steel braces at mitered corners. Provide mounting flange.
- E. Blades: Single piece, overlap frame, parallel action, horizontal orientation, minimum 0.07-inch 6063-T5 extruded aluminum material, maximum 6-inch width.
- F. Bearings: Corrosion-resistant synthetic, formed as single piece with axles.
- G. Blade Seals: Extruded vinyl, mechanically attached to blade edge.

- H. Blade Axles: Corrosion-resistant, synthetic formed as single piece with bearings, locked to blade.
- I. Tie Bars and Brackets: Galvanized steel.
- J. Return Spring: Adjustable tension.
- K. Damper Capacity:
 - 1. Closed Position: Maximum back pressure of 16-inches water gauge.
 - 2. Open Position: Maximum air velocity of 2,500-feet per minute.
- L. Counterbalances: Adjustable zinc plated steel weights mechanically attached to blade. Must be capable of operating over wide range of pressures.
- M. Finish: Mill aluminum.
- N. Temperature Rating: -40 degrees F to 200 degrees F.
- O. Operation of Blade:
 - 1. Start to Open: 0.01-inch wg
 - 2. Fully Open: 0.05-inch.
- P. Pressure Drop: Maximum 0.15-inch wg at 1,500-feet per minute through 24-inch by 24-inch damper.
- Q. Factory Sleeve: Minimum 20 gauge thickness, 12-inches in length.
- R. Screen: At outdoor intake or discharge. 1/4-inch aluminum.

2.3 DAMPERS

- A. Manufacturers:
 - 1. Air Balance
 - 2. Cesco
 - 3. Greenheck
 - 4. Nailor
 - 5. Ruskin
- B. Basis-of-Design:
 - 1. Rectangular ductwork for velocities and pressures up to 1,500 fpm and 2.5-inch wg, respectively: Ruskin MD-35.
 - 2. Rectangular ductwork for velocities and pressures up to 3,000 fpm and 4-inch wg, respectively: Ruskin CD-60.
 - 3. Round ductwork for velocities and pressures up to 3,000 fpm and 4-inch wg, respectively: Ruskin CDSR-15.
- C. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- D. Rectangular Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design with linkage concealed in frame and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum 16 gauge thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - a. Roll-Formed Steel Blades: Galvanized sheet steel, 16 gauge thick for velocities up to 1,500 fpm, and 14 gauge thick for velocities up to 3,000 fpm.
 - b. Blade Axles: Minimum 1/2-inch diameter, plated steel, hex shaped, mechanically attached to blade.
 - c. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
 - d. Tie Bars and Brackets: Galvanized steel.
 - e. Mill galvanized.
 - E. Round Volume Dampers: Single-blade suitable for horizontal or vertical applications.
 1. Steel Frames: Galvanized, roll formed, minimum of 20 gauge thick with beads at each end.
 2. Blades: Minimum 14 gauge thick, galvanized sheet steel, round, single-piece.
 3. Blade Axles: Minimum 1/2-inch square, plated steel, mechanically attached to blade.
 4. Bearings: Molded synthetic sleeve, turning in hole in frame.
 5. Finish: Mill galvanized.
 6. Capacity:
 - a. Closed Position: Maximum pressure of 4-inches wg.
 - b. Open Position: Maximum air velocity of 3,000-feet per minute.
 7. Leakage: Maximum 20 cfm at 4-inches wg.
 8. Pressure Drop: Maximum 0.02-inch wg at 1,500-feet per minute through 20-inch diameter dampers.
 - F. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
 2. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include 2-inch elevated platform for insulated duct mounting.
- 2.4 CONCEALED DAMPER HARDWARE
- A. Manufacturers:
 1. Young Regulator Company
 - B. Concealed Damper Hardware: For dampers above non-removable ceilings (gyp, plaster, decorative, etc.) where access panels have not been shown on Architectural drawings or in locations where dampers are more than 2-feet above the ceiling, provide:
 1. Concealed Damper Regulator: Young Regulator Company Model 315 or approved equivalent.
 2. Cable System: Young Regulator Company or approved equivalent.
 3. Controller: Young Regulator Company 270-275 or approved equivalent.
 4. Control wrenches, wire stops, casing nuts, and stainless steel wire.
 5. Paint cover plate to match ceiling color or as directed by Architect.

2.5 ACCESS DOORS

- A. Manufacturers:

1. Ductmate
 2. Cesco
 3. Ruskin
 4. Nailor
 5. Outdoor Installation: Karp MX insulated exterior access door.
- B. Duct Pressure Class 2-inch WC and Greater: Sandwich-type design with threaded locking bolt assembly. Closed cell neoprene gasket permanently bonded to inside panel. Zinc-coated steel wing nuts or polypropylene molded knobs with threaded metal inserts - zinc coated bolts sealed to inner panel.
- C. Duct Pressure Class 1-1/2-inch WC and Less: Galvanized steel assembly incorporating frame, door, hinges, and latch(es). Frame tabbed for attachment to duct panel. Double wall door panel with 1-inch insulation. Open cell neoprene gasket attached to frame. Cam latches for tight closure.
- D. Plenum Doors: Extruded aluminum frames with extruded santoprene seals. Double-wall 20 gauge galvanized steel door panel with fiberglass insulation.
- E. Size: Maximum size available to fit rectangular duct panel dimension or round duct diameter. Plenum doors minimum 2-feet wide by 4-feet high.
- F. For outdoor installation, only provide waterproof access doors installed vertically.

2.6 DUCT TEST HOLES

- A. Manufacturers:
1. Ventlok
- B. Temporary Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- C. Permanent Test Holes (where shown on Drawings): Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.7 DYNAMIC FIRE DAMPERS

- A. Manufacturers:
1. Ruskin
 2. Greenheck
 3. Nailor
 4. Cesco
 5. Or approved equivalent.
- B. Basis-of Design:
1. Ruskin Model DIBD2, 1-1/2 hour rated
 2. Ruskin Model DIBD23, 3 hour rated
- C. Ratings:
1. Fire Resistance: UL 555 classified and provide fire dampers with UL label for fire rating as appropriate for wall rating and in conformance with NFPA 90A.
 2. Dynamic Closure Rating: Dampers classified for dynamic closure to 2000-feet per minute and 4-inches wg static pressure.
- D. Construction:
1. Frame: Roll formed, galvanized steel channel.

2. Sleeves: Damper to be supplied as a single assembly with an integral factory sleeve.
3. Retaining Angles: Damper to be supplied with factory retaining angles sized to provide installation overlap in accordance with manufacturer's UL listing.
4. Blades: Galvanized curtain type.
5. Closure Springs: Type 301 stainless steel, constant force or spring clip type.
6. Temperature Release Device: 165 degrees F, 212 degrees F, or 285 degrees F.
7. Mounting: Vertical or Horizontal based on application.
8. Finish: Mill galvanized for installation in galvanized sheet metal and Type 304 stainless steel for installation in stainless steel ductwork.

E. Indicator Switches: Not Required.

F. Factory mounting angles and breakaway connections.

G. Factory Tests: Factory cycle damper to assure proper operation.

2.8 STATIC FIRE DAMPERS

A. Manufacturers:

1. Ruskin
2. Greenheck
3. Nailor
4. Cesco
5. Or approved equivalent.

B. Basis-of-Design:

1. Ruskin Model IBD2

C. Fabrication:

1. Fire Rating: UL 555 classified and provide fire dampers with UL label for fire rating as appropriate for wall rating and in conformance with NFPA 90A.
2. Air Flow Rating: UL approved for dual directional air flow.
3. Frame: Maximum 5-inches by minimum 20 gauge roll formed, galvanized steel channel.
4. Blades:
 - a. Style: Curtain type, in airstream.
 - b. Action: Spring or gravity closure upon fusible link release.
 - c. Orientation: Horizontal.
 - d. Material: Minimum 24 gauge roll formed, galvanized steel.
5. Closure Springs: Type 301 stainless steel, constant force type, if required.
6. Temperature Release Device: 165 degrees F, 212 degrees F, or 285 degrees F.
7. Mounting: Vertical or Horizontal, based on application.
8. Finish: Mill galvanized for installation in galvanized sheet metal and Type 304 stainless steel for installation in stainless steel ductwork.
9. Assembly: Factory assemble damper and accessories and furnish as a single unit conforming to UL 555.

D. Performance Data:

1. Temperature Qualified: Damper qualified in accordance with UL 555 as a 1-1/2 hour fire damper.
2. Pressure Drop: Maximum 0.1-inch wg at 2,000-feet per minute through 24-inch wide damper, no sleeve.

E. Indicator Switches: Not required.

- F. Picture Frame Mounting Angles:
 - 1. One-piece, roll formed retaining angles.
 - 2. Factory matched and shipped on individual damper.
 - 3. Factory pre-punched screw holes.
 - 4. Requires factory sleeve.
- G. Factory Sleeve: Minimum 20 gauge thickness, minimum 12-inches length.
- H. Steel Mullions: For dampers in oversized masonry wall openings.
- I. Factory breakaway connection.
- J. Factory Tests: Factory cycle damper to assure proper operation.

2.9 CEILING FIRE DAMPERS

- A. Manufacturers:
 - 1. Ruskin
 - 2. Greenheck
 - 3. Nailor
 - 4. Cesco
- B. Basis-of-Design:
 - 1. Ruskin Model CFD(R)2, 1-1/2 hour rated up to 324 square inches.
 - 2. Ruskin Model CFD(R)3, 3 hour rated up to 324 square inches.
 - 3. Ruskin Model CFD (R)4, 3 hour rated, larger than 324 square inches and smaller than 576 square inches.
 - 4. Ruskin Model CFD(R)5, 3 hour rated for lay-in ceiling diffusers.
 - 5. Ruskin Model CFD7T, Wood truss floor/ceiling and roof/ceiling application.
- C. Fabrication:
 - 1. Fire Rating: UL 555C classified and provide fire dampers with UL label for fire rating as appropriate for ceiling rating, opening size, ceiling construction, and in conformance with NFPA 90A.
 - 2. Air Flow Rating: UL approved for dual directional air flow.
 - 3. Frame: 20 gauge galvanized steel with roll formed ridge for blade stop.
 - 4. Blades:
 - a. Style: Two-piece, single-thickness with blade insulation, hinged in center, and held open with fusible link.
 - b. Action: Butterfly.
 - c. Orientation: Horizontal.
 - d. Material: Minimum 20 gauge galvanized steel.
 - 5. Hinge: Spring stainless steel, mechanically attached to blades.
 - 6. Mounting: Horizontal.
 - 7. Temperature Release Device: 165 degrees F.
 - 8. Finish: Mill galvanized for installation in galvanized sheet metal and Type 304 stainless steel for installation in stainless steel ductwork.
 - 9. Assembly: Factory assemble damper and accessories and furnish as a single unit conforming to UL 555C.
- D. Performance Data:
 - 1. Pressure Drop: Maximum 0.1-inch wg at 500-feet per minute across 18- by 18-inch damper.

- E. Fusible Volume Adjust:
 - 1. UL classified.
 - 2. Permits adjustment of damper blades to balance airflow.
 - 3. Closes damper in fire conditions.
- F. Extended Frame.
- G. Factory Tests: Factory cycle damper assembly to assure proper operation.

2.10 CONTROL DAMPERS

- A. Manufacturers:
 - 1. Ruskin
 - 2. Greenheck
 - 3. Cesco
 - 4. Air Balance
 - 5. Nailor
- B. Basis-of-Design:
 - 1. Ruskin Model CDR25, low leakage, for use in low pressure round ductwork up to 24-inch diameter.
 - 2. Ruskin Model CDO25, low leakage, for use in low pressure oval ductwork.
 - 3. Ruskin Model CD60, ultra low leakage, for rectangular ducts or round ductwork larger than 24-inch diameter. Provide duct transition between round and rectangular connections.
- C. Fabrication:
 - 1. Frame: 16 gauge roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gauge U-channel.
 - 2. Blades (Low Leakage Dampers):
 - a. Style: Single skin with 3 longitudinal grooves.
 - b. Action: Opposed blade for modulating applications, parallel blade for two position application.
 - c. Orientation: Horizontal or vertical with thrust washers.
 - d. Material: Minimum 16 gauge equivalent thickness, galvanized steel.
 - e. Width: Nominal 6-inches.
 - 3. Blades (Ultra Low Leakage Dampers):
 - a. Style: Airfoil-shaped, single-piece.
 - b. Action: Opposed blade for modulating applications, parallel blade for two position applications.
 - c. Orientation: Horizontal or vertical with thrust washers.
 - d. Material: Minimum 14 gauge equivalent thickness, galvanized steel.
 - e. Width: Nominal 6-inches.
 - 4. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
 - 5. Seals:
 - a. Blade: Inflatable PVC coated fiberglass material and galvanized steel. Mechanically attached to blade edge.
 - b. Jamb: Flexible metal compression type.
 - 6. Linkage: Concealed in frame.
 - 7. Axles: Minimum 1/2-inch diameter plated steel, hex-shaped, mechanically attached to blade.

8. Mounting: Vertical or horizontal.
 9. Finish: Mill galvanized for installation in galvanized sheet metal and Type 304 stainless steel for installation in stainless steel ductwork.
- D. Performance Data (Low Leakage Dampers):
1. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
 - a. Closed Position: Maximum pressure of 5-inches wg at a 12-inch blade length.
 - b. Open Position: Maximum air velocity of 2,000-feet per minute.
 2. Leakage: Maximum 3.7 cubic-feet per minute per square foot at 1-inch wg for sizes 36-inches wide and above.
 3. Pressure Drop: Maximum 0.07-inch wg at 1,500-feet per minute across 24-inch by 24-inch damper.
- E. Performance Data (Ultra Low Leakage Dampers):
1. Leakage: Damper to have a maximum leakage of 3 cfm per square foot at 1-inch wg and be AMCA licensed as Class 1A.
 2. Differential Pressure:
 - a. Damper to have a maximum differential pressure rating of 13-inch wg for a 12-inch blade.
 3. Velocity: Damper to have a maximum velocity rating of 6,000-feet per minute.
 4. Temperature: Damper rated for -72 degrees F to 275 degrees F.
 5. Pressure Drop: Maximum 0.1-inch wg at 2,000-feet per minute across 24-inch by 24-inch damper.
- F. Actuator: Provide actuator. See Specification Section 23 09 33, Electric and Electronic Control System for HVAC.
- G. Factory flange frame
- H. Factory Sleeve: Minimum 20 gauge thickness.
- I. Duct Transition Connection: Per Drawings.
- J. Factory Tests: Factory cycle damper assembly to assure proper operation.
- 2.11 TURNING VANES
- A. Manufacturers:
1. Aerodyne
 2. Ductmate Industries
 3. Duro Dyno Corp.
 4. Metalaire Inc.
- B. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners to automatically align vanes.
- C. Manufactured Turning Vanes: For medium pressure ductwork, ductwork upstream of terminal units, and in ductwork with equal inlet width and height dimensions and outlet width and height dimension, provide double thickness airfoil turning vanes. Low pressure ductwork and ductwork downstream of terminal units use either single thickness or double thickness turning vanes. For mitered rectangular elbows with changes in size from inlet to outlet, only use single thickness turning vanes. Use 2-inch radius vanes spaced on centers of 1.5-inches for single thickness. Use 2-inch radius vanes spaced on centers of 2.125-inches for double thickness.

- D. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers:
1. Duro Dyne Corp.
 2. Ventfabrics Inc.
 3. Ductmate Industries
 4. Hardcast
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 4-inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Select metal compatible with ducts.
- D. Provide a spring and bracket assembly to reinforce the fabric with sufficient tension to prevent connector collapse under negative or positive pressure. Number and positioning of spring-link fixture to be determined by the manufacturer to maintain straight axis and without kinks between two sections of duct, or between duct and the moving element. Hardcast Spring-Link SL-200, or equal.
- E. Indoor System, Flexible Connector Fabric (FC-I): Glass fabric double coated with neoprene.
1. Minimum Weight: 30 ounces per square yard.
 2. Tensile Strength: 395 pounds of force per inch in the warp and 255 pounds of force per inch in the filling.
 3. Service Temperature: -40 degrees F to 200 degrees F.
- F. Outdoor System, Flexible Connector Fabric (FC-O): Glass fabric double coated with Hypalon, resistant to UV rays and ozone.
1. Minimum Weight: 26 ounces per square yard.
 2. Tensile Strength: 225 pounds of force per inch in the warp and 300 pounds of force per inch in the filling.
 3. Service Temperature: -40 degrees F to 200 degrees F.
- G. High-Temperature System, Flexible Connectors (FC-HT): Glass fabric coated with silicone rubber.
1. Minimum Weight: 30 ounces per square yard.
 2. Tensile Strength: 372 pounds of force per inch in the warp and 372 pounds of force per inch in the filling.
 3. Service Temperature: -70 degrees F to 500 degrees F.
- H. High-Corrosive-Environment System, Flexible Connectors (FC-HC): Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 ounces per square yard.
 2. Tensile Strength: 450 pounds of force per inch in the warp and 340 pounds of force per inch in the filling.
 3. Service Temperature: -67 degrees F to 500 degrees F.

2.13 AIR FLOW MEASURING STATION (HOT WIRE ANEMOMETER TYPE)

- A. Manufacturers:

1. Ebtron
 2. Air Monitor with Veltron II
 3. Kurz Instruments
 4. Ruskin
 5. Greenheck
- B. Hot wire anemometer probe airflow measuring station, with transmitter, factory calibrated, UL Standard 873 labeled, AMCA 610 certified.
- C. Performance: System accuracy to be percent of reading over the sensor probe operating ranges. Installed accuracy to be better than plus or minus 2 percent of reading over the range of 0 to 5000-feet per minute for duct and plenum probes and plus or minus 3 percent for fan inlet probes.
- D. Filters: Throwaway type, 1-inch thick fiberglass.
- E. Provide electronic transmitter inputs and outputs fused and protected. Provide analog output signals user selectable (0 to 10 VDC or 4 to 20 mA).
- F. Provide interface devices for communication to Building Automation System (BAS/BMS).
- G. Ensure performance over entire operating range of airflow scheduled for each system.

PART 3 - EXECUTION

3.1 DUCT ACCESSORIES GENERAL INSTALLATION

- A. Inspect areas to receive air duct accessories. Notify Engineer of conditions that would adversely affect the installation of the dampers. Do not proceed until conditions are corrected.
- B. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.
- C. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- D. Do not compress or stretch damper frames into duct or opening.
- E. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators, or jack shafts.
- F. Adjust duct accessories for proper settings.

3.2 SHEET METAL MATERIALS INSTALLATION

- A. Install bracing for multiple sections to support assembly weights and hold against system pressure. Install bracing as needed.

3.3 BACKDRAFT DAMPERS INSTALLATION

- A. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated. Provide at outside air intakes where motorized dampers are not shown on drawings.

3.4 DAMPERS INSTALLATION

- A. Where installing volume dampers in ducts with liner, avoid damage to and erosion of duct liner.

- B. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts for air balancing. Install at a minimum of two duct widths from each branch takeoff. Provide balancing dampers for all air inlets and outlets.
 - C. Install dampers square and free from racking with blade running horizontally.
- 3.5 CONCEALED DAMPER HARDWARE INSTALLATION
- A. Coordinate location in Reflected Ceiling Plan and color of concealed damper hardware with Architect prior to installation.
- 3.6 ACCESS DOORS INSTALLATION
- A. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers, turning vanes and equipment.
 - 3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
 - 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
 - 5. Install the following sizes for duct-mounting, rectangular access doors:
 - a. One-Hand or Inspection Access: 8-inches by 5-inches.
 - b. Two-Hand Access: 12-inches by 6-inches.
 - c. Head and Hand Access: 18-inches by 10-inches.
 - d. Head and Shoulders Access: 21-inches by 14-inches.
 - e. Body Access: 25-inches by 14-inches.
 - f. Body Plus Ladder Access: 25-inches by 17-inches.
 - 6. Install the following sizes for duct-mounting, round access doors:
 - a. One-Hand or Inspection Access: 8-inches in diameter.
 - b. Two-Hand Access: 10-inches in diameter.
 - c. Head and Hand Access: 12-inches in diameter.
 - d. Head and Shoulders Access: 18-inches in diameter.
 - e. Body Access: 24-inches in diameter.
 - 7. Label access doors.
- 3.7 DUCT TEST HOLES INSTALLATION
- A. Provide test holes at fan inlets and outlets where indicated and where required for air testing and balancing.
- 3.8 DYNAMIC FIRE DAMPERS INSTALLATION
- A. Adjust fire dampers for proper action.
 - B. Install fire dampers, with fusible links, and in accordance with manufacturer's UL approved written instructions.
- 3.9 STATIC FIRE DAMPERS INSTALLATION
- A. Adjust fire dampers for proper action.
 - B. Install fire dampers, with fusible links, and in accordance with manufacturer's UL approved written instructions.

3.10 CEILING FIRE DAMPERS INSTALLATION

- A. Adjust fire dampers for proper action.
- B. Install fire dampers, with fusible links, and in accordance with manufacturer's UL approved written instructions.

3.11 CONTROL DAMPERS INSTALLATION

- A. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators or jack shafts.
- B. Install control dampers in accordance with manufacturer's written instructions.

3.12 TURNING VANES INSTALLATION

- A. Vanes must be installed, eliminating every other vane is not allowed.
- B. Single thickness vanes cannot be over 36-inches long without intermediate vane runner.
- C. Install per SMACNA and fasten/support to prevent vibration, noise, and to maintain proper alignment at design velocity.

3.13 FLEXIBLE CONNECTORS INSTALLATION

- A. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators. Provide sheet metal weather cover over flexible connections located outdoors. Attach sheet metal to either equipment side or ductwork side, but not both.
- B. Per NFPA, do not use flexible connectors on grease exhaust fans.
- C. Securely attach spring-lock brackets to the metal strips of the connector collar using No. 8 sheet metal screws.
- D. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- E. Adjust the following types in the following locations:
 - 1. FC-I: Indoors.
 - 2. FC-O: Outdoors.
 - 3. FC-HT: High temperature exhaust systems and smoke removal systems.
 - 4. FC-HC: High corrosive systems inclusive of all laboratory exhaust systems.

3.14 AIR FLOW MEASURING STATION (HOT WIRE ANEMOMETER TYPE) INSTALLATION

- A. Provide in ductwork with minimum of 4 diameters of straight ductwork upstream, and 1 diameter of straight ductwork downstream, or as shown on Drawings, whichever is greater.
- B. Control contractor to provide power and control interface wiring unless noted otherwise.
- C. Where provided in equipment, install per manufacturer's installation requirements.

END OF SECTION

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Grilles, Registers, Diffusers

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size and accessories furnished.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Air Distribution Diffuser, Register, and Grille Schedule lists Basis of Design, with any specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design:
 - a. Construction materials and appearance.
 - b. Frame/installation method.
 - c. Isothermal throw plus or minus 5 percent at design flows shown on drawings.
 - d. Noise Criteria: NC value plus or minus 1 at design flows shown on drawings.
 - e. Accessories: Equal to Basis of Design.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23, HVAC sections, where more than a single type is specified for the application, provide single selection for each product category.

- B. Grilles, Registers, Diffusers:
1. Anemostat
 2. Carnes
 3. Environmental Air Products
 4. Krueger
 5. Metalaire
 6. Nailor
 7. Price Co.
 8. Shoemaker
 9. Titus
 10. Tuttle & Bailey
 11. Seiho
 12. Or approved equivalent.

2.2 GRILLES, REGISTERS, DIFFUSERS

- A. Diffuser, Register and Grille Schedule lists Basis of Design, with specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design, including accessories and finish:
1. Matching construction materials and appearance. Equal installation method/frame.
 2. Pressure drop equal to or less than Basis of Design at CFM on Drawings.
 3. Throw: Isothermal jet throw plus or minus 5 percent of Basis of Design at CFM listed on Drawings.
 4. Noise Criteria: Plus or minus 1 NC of Basis of Design at CFM listed on Drawings. If Basis of Design NC is below registered level, submitted must match. NC rating with 10 dB room factor or less.
- B. Provide 1-, 2-, 3-, or 4-way deflection as indicated on Drawings.
- C. Provide pattern controllers for linear supply air diffusers.
- D. Register Dampers: Dampers utilized with grilles. Opposed blade dampers utilizing a side operated worm drive which provides external duct operation. Slot the end of the shaft to receive a screwdriver. Factory assembled side operator. Construct of the same material as the grille. Manufacturer same as grilles/diffuser.
- E. Coordinate mounting frames with ceiling construction type. Verify per reflected ceiling plans.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Install in accordance with manufacturer's instructions. Provide seismic supports, clips, and bracing per local code. Coordinate installation of framing. Provide complete coverage of rough openings by integral device flanges or auxiliary frames. Where above ceiling location is unconditioned space, caulk rough openings; repair and re-paint locations where dust entrainment streaks develop due to unsealed openings.
- B. Damp locations, such as lockers, restrooms, showers, natatoriums, whirlpool/spas, to have aluminum construction even if scheduled otherwise; mounting hardware to be stainless steel.
- C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

- D. Unless otherwise shown on drawings, for ceiling mounted air outlets with adjustable airflow pattern controllers mounted at a height of 12 feet or less, adjust the air outlets for horizontal air distribution, and adjust to vertical air distribution for ceiling height above 12 feet.
- E. Exterior color of grilles per Architect. White finish if not otherwise scheduled or noted by Architect. Paint ductwork visible behind air outlets and inlets matte black.
- F. Ceiling Membrane: Protect ceiling membrane per code. Fire caulk around openings. Provide listed radiation damper in rated roof/ceiling or floor/ceiling assemblies as required per code.
- G. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

3.2 GRILLES, REGISTERS AND DIFFUSERS INSTALLATION

- A. Coordinate with Architectural Reflected Ceiling Plan(s). Reflected ceiling plans determine final locations.
- B. Install diffusers to ductwork with air tight connection. 18-inch straight duct section or acoustic plenum at connection. Provide square to round adapters where required for connection to round ducts.
- C. Provide integral balancing dampers for diffusers, and grilles and registers where duct manual balancing dampers are not shown or specified.
- D. Linear Slot Diffusers:
 - 1. Coordinate connection plenum dimensions with linear slot final dimensions to conform with manufacturer's recommendations, or as indicated. Total and active lengths as noted on drawings. Blank off unused sections. Coordinate frame type with Architect.
 - 2. Paint surfaces visible behind air outlets and inlets, including blank-off sections, matte black unless otherwise called for on drawings.

END OF SECTION

SECTION 238126 - SMALL SPLIT SYSTEM AND UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Materials, installation and testing of:
 - 1. Ductless Split Systems - Cooling Only

1.2 RELATED SECTIONS

- A. Contents of Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.
- B. In addition, meet the following:
 - 1. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.
- B. In addition, meet the following:
 - 1. Efficiency ratings, cooling/heating performance, fan performance, sound performance to meet or exceed Basis of Design as scheduled on Drawings.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.
- B. In addition, provide:
 - 1. Refrigeration compressor(s): 5-year warranty.
 - 2. Furnace heat exchanger: 5-year warranty.

PART 2 - PRODUCTS

2.1 DUCTLESS SPLIT SYSTEMS - COOLING ONLY

- A. Manufacturers:
 - 1. Mitsubishi
 - 2. Sanyo
 - 3. Daikin Applied
 - 4. LG
 - 5. Friedrich
 - 6. Fujitsu

- B. Description: Self-contained, matched factory-engineered and assembled. Pre-wired indoor and outdoor units. UL/ETL listed.
- C. Outdoor Unit:
1. Self contained, consisting of cabinet, compressor system, condenser fan matched to indoor unit.
 2. Cabinet: Fabricated of galvanized steel, bonderized, and finished with powder coated baked enamel.
 3. Refrigerant System:
 - a. HFC refrigerant or other refrigerant with zero ozone depletion potential (ODP).
 - b. Compressor: To be inverter driven, hermetic rotary type.
 4. Air System:
 - a. Fan: Propeller Type with one direct drive, inverter driven, variable speed motor.
 - b. Motor: Premium efficiency with inherent protection, permanently lubricated bearings and variable speed drive compatible.
 - c. Coil: Copper tubes and aluminum fins, coated for corrosion protection.
 5. Controls: Single source for both indoor and outdoor units, with low/high pressure switch, capable of communicating to/from the building DDC control system.
- D. Indoor Unit(s):
1. Self contained wall mounted, ceiling mounted or recessed ceiling mounted evaporator unit(s) as shown on Drawings, matched to outdoor unit.
 2. Cabinet:
 - a. Non-flammable, high impact polymer with a white finish.
 - b. Power Source: To be a single point power connection or sub-fed from outdoor condensing unit.
 3. Refrigeration System: HFC refrigerant or other refrigerant with zero ozone depletion potential (ODP).
 4. Air System:
 - a. Fan: An assembly with one or two inline fan(s) with a single direct drive motor.
 - b. Filter: Polypropylene, furnished with the unit, removable and washable.
 - c. Coil: Direct expansion type with copper tubes mechanically bonded into aluminum fins.
 5. Condensate Drain:
 - a. Provide drain pan sloped to drain away from unit. Drain pan with a single drain connection.
 - b. Condensate pump kit provided with unit.
 - c. Secondary drain pan; Condensate overflow shut-off float switch and external alarm.
 6. Controls: Wired thermostat. Control to be integral with unit.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install with required clearances and access for maintenance.
- B. Install factory furnished devices for field installation.
- C. Inspect for and remove shipping bolts, blocks and tie-down straps.
- D. After energizing units: Test units for proper fan rotation. Test and adjust controls and internal safeties. Replace malfunctioning units and retest.

- E. Thoroughly clean exposed portions of equipment. Install new filters prior to final test and balance and again prior to final acceptance.
- F. Provide vibration isolation: As scheduled.
- G. Condensate drain per manufacturer's piping diagram.
- H. Condensate piped to indirect waste connection; cleanouts at changes of direction; sized and sloped to drain per Code. Secondary drain routed to visible location.
- I. Shut-off/hose kits for all hydronic connections.

END OF SECTION

SECTION 260000 - ELECTRICAL BASIC REQUIREMENTS**PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Work included in 26 00 00, Electrical Basic Requirements applies to Division 26, Electrical work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electrical systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

- A. Contents of Section applies to Division 26, Electrical Contract Documents.
- B. Related Work:
 - 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 26, Electrical Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:

1. State of Virginia:
 - a. 2015 International Building Code (IBC) with corresponding Virginia Construction Code Supplement
 - b. 2015 International Mechanical Code (IMC) with corresponding Virginia Construction Code Supplement
 - c. 2015 International Plumbing Code (IPC) with corresponding Virginia Construction Code Supplement
 - d. 2015 International Fuel Gas Code (IFGC) with corresponding Virginia Construction Code Supplement
 - e. 2014 National Electric Code (NFPA 70-2011) with corresponding Virginia Construction Code Supplement
 - f. 2015 International Energy Conservation Code (IECC) with corresponding Virginia Construction Code Supplement
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 1. ABA - Architectural Barriers Act
 2. ADA - Americans with Disabilities Act
 3. ANSI - American National Standards Institute
 4. APWA - American Public Works Association
 5. ASCE - American Society of Civil Engineers
 6. ASHRAE Guideline 0, the Commissioning Process
 7. ASTM - ASTM International
 8. CFR - Code of Federal Regulations
 9. EPA - Environmental Protection Agency
 10. ETL - Electrical Testing Laboratories
 11. FCC - Federal Communications Commission
 12. FM - FM Global
 13. IBC - International Building Code
 14. IEC - International Electrotechnical Commission
 15. IEEE - Institute of Electrical and Electronics Engineers
 16. IES - Illuminating Engineering Society
 17. ISO - International Organization for Standardization
 18. MSS - Manufacturers Standardization Society
 19. NEC - National Electric Code
 20. NECA - National Electrical Contractors Association
 21. NEMA - National Electrical Manufacturers Association
 22. NETA - National Electrical Testing Association
 23. NFPA - National Fire Protection Association
 24. OSHA - Occupational Safety and Health Administration
 25. UL - Underwriters Laboratories Inc.
- D. See Division 26, Electrical individual Sections for additional references.

1.4 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as individual Division 26, Electrical Sections.

- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. Deviations will be returned without review.
 - a. Provide separate submittals for power system study (per Specification Section 26 05 73) and electrical equipment (for example, switchboards and panelboards).
 - b. Provide separate submittals for lighting control cutsheets, and for lighting control shop drawings.
 3. Product Data: Provide manufacturer's descriptive literature for products specified in Division 26, Electrical Sections.
 4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.
 - a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 26, Electrical specification Sections for specific items required in product data submittal outside of these requirements.
 - c. See Division 26, Electrical individual Sections for additional submittal requirements outside of these requirements.
 5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
 6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.

7. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 26, Electrical Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals. Electric motors are supplied and installed by Division 23 unless otherwise specified. During shop drawing stage of the project, verify correct disconnect sizes, conductor sizes, etc., and bring any discrepancies to the attention of the Mechanical trade. Be responsible for any modifications to electrical equipment or installations as a result of equipment incompatibility discovered after shop drawing review.
8. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
9. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
10. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 26, Electrical specification Sections for additional requirements for shop drawings outside of these requirements.
 - a. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
11. Samples: Provide samples when requested by individual Sections.
12. Resubmission Requirements:
 - a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 - b. Resubmit for review until review indicates no exception taken or "make corrections as noted".
13. Operation and Maintenance Manuals, Owner's Instructions:
 - a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order

format as submittals. Include name and location of source parts and service for each piece of equipment.

- 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment.
 - 3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
 - 4) Include product certificates of warranties and guarantees.
 - 5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 6) Include commissioning reports.
 - 7) Include copy of startup and test reports specific to each piece of equipment.
 - 8) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
- b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 26 00 00, Electrical Basic Requirements, Demonstration.
- c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
14. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of conduit, and location of concealed electrical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
 - c. At completion of project, input changes to original project on Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit Revit disk and drawings upon substantial completion.
 - d. See Division 26, Electrical individual Sections for additional items to include in record drawings.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e. distribution equipment, duct banks, light fixtures, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.

1.6 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, lights, cable tray and electrical services with architectural and structural requirements, and other trades (including ceiling suspension and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

- C. Verify in field exact size, location, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by state, county, and city authorities. Equipment/fixture supplier is responsible for obtaining State, County, and City acceptance on equipment/fixtures that are not UL approved or are not listed for installation.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of Virginia, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Install equipment requiring access (i.e., junction boxes, light fixtures, power supplies, motors, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in passageways, doorways, scuttles or crawlspaces which would impede or block the intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:

1. Confirm Earthwork requirements in Contract Documents. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
 - E. Firestopping:
 1. Confirm requirements in Division 07, Thermal and Moisture Protection. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - F. Plenums:
 1. In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.
 - G. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
 - H. Provide miscellaneous supports/metals required for installation of equipment and conduit.
- 3.2 REVIEW AND OBSERVATION
- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
 - B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 1. Underground conduit installation prior to backfilling.
 2. Prior to covering walls.
 3. Prior to ceiling cover/installation.
 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
 - C. Final Punch:
 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Electrical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the electrical systems are ready for final punch.
 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.3 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
1. During remodeling or addition to existing structure, while existing structure is occupied, present services to remain intact until new construction, facilities or equipment is installed.
 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new wiring, and wiring to point of connection.
 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off-peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 4. No interruption of services to any part of existing facilities will be permitted without express permission in each instance from Owner. Requests for outages must state specific dates, hours and maximum durations, with outages kept to these specific dates, hours and maximum durations. Obtain written permission from Owner for any interruption of power, lighting or signal circuits and systems.
 - a. Organize work to minimize duration of power interruption.
 - b. Coordinate utility service outages with utility company.

3.4 CUTTING AND PATCHING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements in Division 01, General Requirements, comply with individual Division 26, Electrical Sections and the following:
1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
 4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and/or walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.

5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.5 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.6 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage and handling to be replaced before installation.
 2. Protect equipment to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bus duct and similar items until in service.

3.7 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, and individual Division 26, Electrical Sections.
- B. Upon completion of work and adjustment of equipment, test systems and demonstrate to Owner's Authorized Representative, Architect, and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.8 CLEANING

- A. Confirm Cleaning requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Upon completion of installation, thoroughly clean electrical equipment, removing dirt, debris, dust, temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.9 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.

- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- D. Provide miscellaneous supports/metals required for installation of equipment.

3.10 PAINTING

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces (i.e., hangers, hanger rods, equipment stands, etc.) with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. In Electrical Room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Conduit: Clean, primer coat and paint interior/exterior conduit exposed in public areas with two coats paint suitable for metallic surfaces. Color selected by Architect.
 - 6. Covers: Covers such as manholes, vaults and the like will be furnished with finishes which resist corrosion and rust.

3.11 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 - 1. It is the intent of these documents to provide necessary information and adjustments to electrical system required to meet code, and accommodate installation of new work.
 - 2. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
 - 3. Examination:
 - a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
 - b. Verify that abandoned wiring and equipment serve only abandoned facilities.
 - c. Demolition drawings are based on casual field observation and existing record documents.
 - 1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.

- 2) Verify location and number of electrical outlets, luminaires, panels, etc. in field.
- d. Report discrepancies to Architect before disturbing existing installation.
 - 1) Promptly notify Owner if utilities are found which are not shown on Drawings.
4. Execution:
 - a. Remove existing luminaires, switches, receptacles, and other electrical equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.
 - b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring, equipment, and luminaires, as encountered in removed or remodeled areas in existing construction affected by this work.
 - c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
 - d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass inaccessible junction boxes and abandoned outlets.
 - e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.
 - f. Extend circuiting and devices in existing walls to be furred out.
 - g. Remove abandoned wiring to source of supply.
 - h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
 - i. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
 - j. Disconnect and remove abandoned panelboards and distribution equipment.
 - k. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
 - l. Existing lighting which is to remain, leave luminaires in proper working order.
 - m. Repair adjacent construction and finishes damaged during demolition work.
 - n. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

3.12 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In the absence of specific requirements, comply with individual Division 26, Electrical Sections and the following:
 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Cleaning
 - b. Operation and Maintenance Manuals
 - c. Training of Operating Personnel

- d. Record Drawings
- e. Warranty and Guaranty Certificates
- f. Start-up/Test Document and Commissioning Reports

3.13 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 26 00 00, Electrical Basic Requirements and individual Division 26, Electrical Sections.
- B. Tests:
 - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
 - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.14 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that Electrical items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.15 SALVAGED EQUIPMENT AND RECYCLED MATERIAL

- A. Salvage the following equipment not being reused and return to Owner:
 - 1. Luminaires
 - 2. Panelboards
 - 3. Breakers
 - 4. Transformers
- B. Electrical equipment that cannot be salvaged for reuse, sell/give to recycling company. Recycle following excess, removed, or demolished electrical material:
 - 1. Copper or aluminum conductors, buses, and motor/transformer windings.
 - 2. Steel and aluminum from raceways, boxes, enclosures, and housings.
 - 3. Acrylic and glass from luminaire lenses/refractors.
- C. Provide separate on-site storage space for recycled and salvaged material. Clearly label space.
- D. Confirm additional salvaged equipment and recycled materials in the Contract Documents.

END OF SECTION

SECTION 260501 - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Materials and Equipment

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements and circuiting arrangements are as shown on Drawings.
- B. Determine the exact location of existing utilities and equipment before commencing work, compensate the Owner for damages caused by the failure to locate and preserve utilities. Replace damaged items with new material to match existing.
- C. Verify that abandoned wiring and equipment serve only abandoned facilities.
- D. Demolition drawings are based on casual field observation and existing record documents.
 - 1. Verify the accuracy of the information shown prior to bidding and provide such labor and material as is necessary to accomplish the work.
 - 2. Verify location and number of electrical outlets in the field.
- E. Report discrepancies to Owner before disturbing existing installation.
- F. Report discrepancies to Architect before disturbing existing installation.
- G. Beginning of demolition means installer accepts existing conditions without exception.

3.2 PREPARATION

- A. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access, and access to different areas. The Owner will cooperate to the best of their ability to assist in a coordinated schedule, but will remain the final authority as to time of work permitted.
- B. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- C. Coordinate utility service outages with utility company.
- D. Interruption of services (power, telephone, fire alarm, communication systems) to existing facilities: not permitted without express permission in each instance from the Owner.
 - 1. Requests for service outages: State specific dates, hours and the maximum duration.
 - 2. Written permission: Obtain from Owner for interruption of power, lighting or signal circuits and systems.
 - 3. Organize the work to minimize duration of service interruptions.
 - 4. Provide temporary wiring and connections to maintain existing systems in service during construction.
- E. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- F. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections.
 - 1. Obtain permission from Owner at least five (5) working days before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.
- G. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections.
 - 1. Notify Owner before partially or completely disabling system.
 - 2. Notify local fire service.
 - 3. Make notifications at least five (5) working days in advance.
 - 4. Make temporary connections to maintain service in areas adjacent to work area.
- H. Overtime and shift work: Provide as required to maintain continuity of services during normal working hours of the occupied building.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- E. Disconnect and remove abandoned panelboards and distribution equipment.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

- G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- H. Reroute wiring clear of demolition which serve existing outlets that remain and reconnect back to source.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- K. Furred out walls/columns: extend circuiting and outlets.
- L. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires to remain: Remove luminaires for cleaning. Use mild detergent to clean exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

3.5 SALVAGED EQUIPMENT AND RECYCLED MATERIAL

- A. Salvage the following equipment not being reused and return to Owner:
 - 1. Luminaires
 - 2. Panelboards
 - 3. Breakers
 - 4. Transformers
 - 5. Disconnects
- B. Electrical equipment that cannot be salvaged for reuse sell/give to recycling company. Recycle the following excess, removed, or demolished electrical material:
 - 1. Copper or aluminum conductors, buses, motor/transformer windings, and the like.
 - 2. Steel and aluminum from raceways, boxes, enclosures, housings and the like.
 - 3. Acrylic and glass from luminaire lenses/refractors.
- C. Provide separate on-site storage space for recycled and salvaged material. Clearly label space.

END OF SECTION

SECTION 260509 - EQUIPMENT WIRING**PART 1 - GENERAL****1.1 SUMMARY****A. Work Included:**

1. Equipment connections, whether furnished by Owner or other Divisions of the Contract.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition:
 1. Verify mechanical and utilization equipment electrical characteristics with Drawings and equipment submittals prior to ordering equipment. Submit confirmation of this verification as a part of, or addendum to, the electrical product submittals.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Materials and Equipment for Equipment Wiring: As specified in individual Sections.

2.2 GENERAL

- A. Unless otherwise noted, the following voltage and phase characteristics apply to motors:
 1. 3/4 HP and Under: 120 volt, 1 phase.
 2. 1 HP and Less than 5 HP Loads: 480 volt, 3 phase.
 3. 5 HP and Over: 480 volt, 3 phase.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Prior to submittal of product data for electrical distribution equipment, obtain and examine product data and shop drawings for equipment furnished by the Owner and by other trades on the project. Update the schedule of equipment electrical connections accordingly, noting proper ratings for overcurrent devices, fuses, safety disconnect switches, conduit and wiring,

and the like. As a minimum, this requirement applies to equipment furnished by Owner and equipment furnished under the following divisions of work under this contract:

1. Division 8, Openings
2. Division 11, Equipment
3. Division 21, Fire Suppression
4. Division 22, Plumbing
5. Division 23, HVAC, Heating, Ventilating and Air Conditioning
6. Division 27, Communications
7. Division 28, Electronic Safety and Security

3.2 INSTALLATION

- A. Do not install unrelated electrical equipment or wiring on mechanical equipment without prior approval of Engineer.
- B. Provide moisture tight equipment wiring and switches in ducts or plenums used for environmental air.
- C. Connect motor and appliance/utilization equipment complete from panel to motor/equipment as required by code.
- D. Install motor starters and controllers for equipment furnished by others.
- E. Appliance/Utilization Equipment:
 1. Provide appropriate cable and cord cap for final connection unless equipment is provided with same. Provide receptacle configured to receive cord cap.
 2. Verify special purpose outlet NEMA configuration and ampere rating with equipment supplier prior to ordering wiring devices and coverplates.

3.3 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Division 01, General Requirements.

3.4 SYSTEMS STARTUP

- A. Provide field representative to prepare and start equipment.
 1. Test and correct for proper rotation of polyphase motors.
- B. Adjust for proper operation within manufacturer's published tolerances.
- C. Demonstrate proper operation of equipment to Owner's Authorized Representative.

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Lugs and Pads
 - 2. Wires and Cables
 - 3. Splices
 - 4. Connectors

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Cable insulation test reports in project closeout documentation.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Lugs and Pads:
 - 1. Anderson
 - 2. IlSCO
 - 3. Panduit
 - 4. Thomas & Betts
 - 5. 3M
 - 6. Or approved equivalent.
- B. Wires and Cables:
 - 1. General:
 - a. General Cable
 - b. Okonite
 - c. Southwire
 - d. Encore Wire

- e. Or approved equivalent.
 - 2. Metal Clad Cable - Type MC:
 - a. Alflex
 - b. AFC
 - c. General Cable
 - d. Southwire
 - e. Encore Wire
 - f. Or approved equivalent.
 - C. Splices:
 - 1. Branch Circuit Splices:
 - a. Ideal
 - b. 3M Scotchlok
 - c. Uraseal, Inc.
 - d. Or approved equivalent.
 - 2. Feeder Splices:
 - a. Not allowed.
 - D. Connectors:
 - 1. Anderson Power Products
 - 2. Burndy
 - 3. Ilsco
 - 4. 3M
 - 5. Thomas & Betts
 - 6. Or approved equivalent.
- 2.2 LUGS AND PADS
- A. Ampacity: Cross-sectional area of pad for multiple conductor terminations to match ampere rating of panelboard bus or equipment line terminals.
 - B. Copper Pads: Drilled and tapped for multiple conductor terminals.
 - C. Lugs: Compression type for use with stranded branch circuit or control conductors; mechanical lugs for use with solid branch and feeder circuit conductors.
- 2.3 WIRES AND CABLES
- A. Building Wires:
 - 1. Copper: Soft-drawn with conductivity of not less than 98 percent IACS at 20 degrees C (68 degrees F). 600 volt rated throughout. Conductors 12 AWG and 10 AWG, solid. Conductors 8 AWG and larger, stranded. 12 AWG minimum conductor size. Minimum insulation rating of 90 degrees C. Insulation Type: THHN/THWN-2.
 - 2. Aluminum conductors are not permitted unless written approval is received from the Engineer.
 - 3. Aluminum (if permitted): Insulation type and rating to match copper wiring. Compact stranded. Aluminum Association 8000(AA-8000) Series alloy conductor material built to ASTM B800, B801, and B836 specifications.
 - B. Phase color to be consistent at feeder terminations; A-B-C, top to bottom, left to right, front to back.
 - C. Color Code Conductors as Follows:

PHASE	208 VOLT WYE	240 VOLT DELTA	480 VOLT
A	Black	Black	Brown
B	Red	Orange (High Leg)	Orange
C	Blue	Blue	Yellow
Neutral	White	White	Gray or White w/colored strip
Ground	Green	Green	Green
Isolated Ground	Green w/yellow trace	N/A	N/A

D. MC Cable:

1. Standard: High strength galvanized steel flexible armor with insulated ground wire. Full length minimum size No. 12 copper ground wire, copper dual rated THHN/THWN-2, full length tape marker phase/circuit identification on cable armor. Short circuit throat insulators, mechanical compression termination.

E. AC Cable (Armored Cable): Not allowed.

F. NMB Cable: Not allowed.

2.4 SPLICES

A. Branch Circuits: Twist on, high temperature, grounding type wing nuts.

1. Ideal Industries Wing-Nut Twist-On Connectors.
2. 3M Scotchlok Twist-On Wire Connectors.

2.5 CONNECTORS

A. Split bolt connectors not allowed.

B. Conductor Branch Circuits: Wire nuts with integral spring connectors for conductors 12 AWG through 8 AWG. Push-in type connectors where conductors are not required to be twisted together are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install per manufacturer instructions and NEC.

B. Field Quality Control:

1. Test conductor insulation on feeders of 100 amp and greater for conformity with 1000 volt megohmmeter. Use Insulated Cable Engineers Association testing procedures. Minimum insulation resistance acceptable is 1 megohm for systems 600 volts and below. Notify Architect if insulation resistance is less than 1 megohm.
2. Test Report: Prepare a typed tabular report indicating the testing instrument, the feeder tested, amperage rating of the feeder, insulation type, voltage, the approximate length of the feeder, conduit type, and the measured resistance of the megohmmeter test. Submit test reports with project closeout documents.
3. Inspect and test in accordance with NETA Standard ATS, except Section 4.
4. Perform inspections and tests listed in NETA Standard ATS, Section 7.3.2.

3.2 LUGS AND PADS

A. Thoroughly clean surfaces to remove all dirt, oil, grease or paint.

- B. Use torque wrench to tighten per manufacturer's directions.

3.3 WIRES AND CABLES

A. General:

1. Do not install or handle thermoplastic insulated wire and cable in temperatures below -10 degrees C (14 degrees F). Do not handle thermoset insulated wire and cable in temperatures below -40 degrees C (-40 degrees F). All wire and cable must be acclimated to temperatures above freezing for no less than 24 hours prior to installation.
2. Install conductors in raceways having adequate, code size cross-sectional area for wires indicated.
3. Install conductors with care to avoid damage to insulation.
4. Do not apply greater tension on conductors than recommended by manufacturer during installation.
5. Use of pulling compounds is permitted. Clean residue from exposed conductors and raceway entrances after conductor installation. Do not use pulling compounds for installation of conductors connected to GFCI circuit breakers or GFCI receptacles.
6. Additional Requirements for Aluminum Conductors (If Permitted):
 - a. Equipment connected to aluminum conductors to be specifically approved for the purpose, and marked as such. Pay particular attention to refrigeration and similar equipment. Do not use aluminum wire to make connections to mechanical equipment.
 - b. Make connection of aluminum conductors to wiring devices having wire-binding terminal screws, around which conductors can be looped under the head of the screw, by forming the conductor in a clockwise direction around the screw into three-fourths of a complete loop. Only one conductor connected to any one screw.
7. Conductor Size and Quantity:
 - a. Install no conductors smaller than 12 AWG unless otherwise shown.
 - b. Provide required conductors for a fully operable system.
 - c. Power Circuits: No. 12 AWG minimum, except as follows:
 - 1) No. 10 AWG for 15A, 120V circuits longer than 100 ft.
 - 2) No. 8 AWG for 15A, 120V circuits longer than 150 ft.
 - 3) No. 10 AWG for 20A, 120V circuits longer than 70 ft.
 - 4) No. 8 AWG for 20A, 120V circuits longer than 100 ft.
 - d. When exact run lengths are determined for all branch circuits, and prior to installation of the conductors, ensure that the maximum voltage drop, based on 80 percent of the circuit protective device, does not exceed 3 percent. Increase wire size from #12AWG, if necessary, to ensure that the 3 percent voltage drop is not exceeded.
8. Provide dedicated neutrals (one neutral conductor for each phase conductor) in all 120V circuits.

B. Conductors in Cabinets:

1. Cable and tree wires in panels and cabinets for power and control. Use plastic ties in panels and cabinets.
2. Tie and bundle feeder conductors in wireways of panelboards.
3. Hold conductors away from sharp metal edges.

C. Homeruns:

1. Do not change intent of branch circuit homeruns without approval. Homeruns for 20A branch circuits may be combined to a maximum of six current carrying conductors including neutral conductors in homeruns. Apply derating factors as required per NEC. Increase conductor size as needed.
 2. MC cable homeruns are not allowed unless indicated on drawings.
- D. Identify wire and cable under the provisions of Section 26 05 53, Identification for Electrical Systems. Identify each conductor with its panel and circuit number as indicated.
- E. Exposed cable is not allowed.
- F. All cable must be run parallel or perpendicular to building lines and hidden from view when possible. Where installed in tray each power cable is to be identified with Lamacoid nametag engraved with identification of equipment being fed. Tag to be fastened to cable using tie-wraps. Provide nametag at each floor level.
- G. Do not install PVC jacketed cables in return air plenums, unless they are specially rated plenum cables.
- H. Use of MC Cable is limited to the following conditions. Installations that do not comply with the following conditions are to be removed and replaced with no additional expense to the Owner.
1. 15 and 20 amp branch wiring where following conditions apply:
 - a. MC cable is allowed for branch circuits, including both lighting and power outlets, as allowed by code and restricted below.
 - b. Use MC cable for final flexible connections from junction or outlet boxes to recessed fixtures. Each individual luminaire is to be serviced by an individual cable drop from the associated junction box in the ceiling space. Luminaire drops secured to, and supported by, the building structure with nylon tie wraps. The use of the ceiling suspension system for support of any type of cabling is not permitted.
 - c. MC cable may be routed in the void space above hard lid ceilings, and routed within wall cavities below glazing, provided NEC requirements are otherwise met, and a minimum one 0.75-inch conduit is routed from nearest accessible ceiling space to inaccessible location, terminating in a j-box with blank faceplate, for future circuits.

3.4 SPLICES

- A. Make splices complete and promptly after wire installation. Provide single wire pigtails for luminaire and device connections. Wire nuts may be used for luminaire wire connections to single wire circuit conductor pigtails.
- B. Make splices for No. 8 and larger wires with mechanically applied pressure type connectors. Make all taped joints with Scotch 33+ or equal, applied in half-lap layers without stretching to deform. Uraseal splice kits are also acceptable through 250 KCMIL.
- C. Remove insulation with a stripping tool designed specifically for that purpose. A pocket knife is not an acceptable tool. Leave all conductors nick-free.

3.5 CONNECTORS

- A. Install to assure a solid and safe connection.
- B. Select hand twist connectors for wire size and install tightly on conductors.
- C. Install compression connectors using methods and tools recommended by the manufacturer.

- D. Do not install stranded conductors under screw terminals unless compression lugs are installed.
- E. Do not connect wiring without UL listed connectors that are listed for the purposes.

END OF SECTION

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Grounding Electrodes
 - 2. Connectors and Accessories
 - 3. Grounding Busbar
 - 4. Grounding Conductor

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Test reports of ground resistance for service and separately derived system grounds.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Comply with the requirements of ANSI/NFPA 70.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Grounding Electrodes:
 - 1. Erico
 - 2. Thomas & Betts
 - 3. Talley
 - 4. Or approved equivalent.
- B. Connectors and Accessories:
 - 1. Burndy Hyground Compression System
 - 2. Erico/Cadweld
 - 3. Amp Ampact Grounding System
 - 4. Pipe Grounding Clamp:
 - a. Burndy GAR Series

- b. O Z Gedney
 - c. Thomas & Betts
 - d. Or approved equivalent.
 - C. Grounding Busbar:
 - 1. Chatsworth
 - 2. Erico
 - 3. Schneider Electric/Square D
 - 4. Panduit
 - 5. Or approved equivalent.
 - D. Grounding Conductor
 - 1. General Cable
 - 2. Okonite
 - 3. Southwire
 - 4. Or approved equivalent
- 2.2 GROUNDING ELECTRODES
- A. Ground Rods: Copper-clad steel, minimum 3/4-inch diameter, 10-foot long, tapered point, chamfered top.
- 2.3 CONNECTORS AND ACCESSORIES
- A. Grounding Connectors: Hydraulic compression tool applied connectors or exothermic welding process connectors or powder actuated compression tool applied connectors.
 - B. Pipe Grounding Clamp: Mechanical ground connector with cable parallel or perpendicular to pipe.
- 2.4 GROUNDING BUSBAR
- A. Grounding Busbar: 1/4-inch thick by 4-inch high by 10-inch long copper grounding busbar with insulators that meet ANSI J-STD-607-A specifications. UL 467 listed. Hole patterns in busbar to accommodate two-hole lugs, four-hole configuration.
- 2.5 GROUNDING CONDUCTOR
- A. Grounding Electrode Conductor: Soft-draw bare stranded copper for wire sizes larger than #10 AWG Bare. Solid copper for wire sizes #10 AWG and smaller.
 - B. Equipment Grounding Conductor: Green insulated, insulation type to match that of associated feeder or branch circuit wiring, size as indicated on drawings.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Verify site conditions prior to beginning work.
- B. Bond Sections of service equipment enclosure to service ground bus.
- C. Separately Derived Systems: Ground each separately derived system per NEC Article 250.
- D. Corrosion inhibitors: Apply a corrosion inhibitor to contact surfaces when making grounding and bonding connections. Use corrosion inhibitor appropriate for protecting a connection between metals used.

- E. Grounding system resistance to ground not to exceed 5 ohms. Make necessary modifications or additions to grounding electrode system for compliance. Submit final tests to assure that this requirement is met.
- F. Resistance of grounding electrode system: measure using a four-terminal fall-of-potential method as defined in IEEE 81. Take ground resistance measurements before electrical distribution system is energized and in normally dry conditions, not less than 48 hours after last rainfall. Take resistance measurements of separate grounding electrode systems before systems are bonded together below grade. Combined resistance of separate systems may be used to meet required resistance, but specified number of electrodes must still be provided.
- G. Inspect and test in accordance with NETA Standard ATS, Except Section 4.
- H. Perform inspections and tests listed in NETA Standard AB, Section 7.13.

3.2 GROUNDING ELECTRODES INSTALLATION

- A. Ground Rod Electrode:
 - 1. Verify that final backfill and compaction have been completed before driving rod electrodes.
 - 2. Bond #6 grounding electrode conductor to driven ground rods as indicated on Drawings.
 - 3. Tap at center ground rod and extend grounding electrode conductor to service grounding bus. Install grounding electrode conductor to service grounding bus in rigid PVC conduit for physical protection where grounding electrode conductor passes through concrete floor or other concrete structure.
- B. Metal Underground Water Service: Bond water service pipe to service equipment ground bus or to the grounding electrode system. Connect to water pipe on utility side of isolating fittings or meters, bond across water meters.
- C. Other Metal Piping Systems: Bond gas piping system, fire sprinkler piping system and other metal piping systems to service equipment ground bus or to the grounding electrode system.
- D. Bond together metal siding not attached to grounded structure; bond to grounding electrode system.

3.3 CONNECTORS AND ACCESSORIES INSTALLATION

- A. Install per manufacturer's instructions.

3.4 GROUNDING BUSBAR INSTALLATION

- A. Install per manufacturer's instructions.

3.5 GROUNDING CONDUCTOR INSTALLATION

- A. Raceways:
 - 1. Ground metallic raceway systems. Bond to ground terminal with code size jumper except where code size or larger equipment grounding conductor is included with circuit, use grounding bushing with lay-in lug.
 - 2. Connect metal raceways, which terminate within an enclosure but without mechanical connection to enclosure, by grounding bushings and ground conductor to grounding bus.
 - 3. Where equipment supply conductors are in flexible metallic conduit, install stranded copper equipment grounding conductor from outlet box to equipment frame.
 - 4. Install equipment grounding conductor, code size minimum unless noted on drawings, in metallic and nonmetallic raceway systems.

- B. Feeders and Branch Circuits:
 - 1. Provide continuous green insulated copper equipment grounding conductors for feeders and branch circuits.
 - 2. Where installed in a continuous solid metallic raceway system and larger sizes are not detailed, provide insulated equipment grounding conductors for feeders and branch circuits sized in accordance with the latest adopted edition of NEC Article 250, Table 250-122.
- C. Bond boxes, cabinets, enclosures and panelboard equipment grounding conductors to enclosure with specified conductors and lugs. Install lugs only on thoroughly cleaned contact surfaces.
- D. Motors, Equipment and Appliances: Install code size equipment grounding conductor to (motor) equipment frame or manufacturer's designated ground terminal.
- E. Receptacles: Connect ground terminal of receptacle and associated outlet box to equipment grounding conductor. Self grounding nature of receptacle devices does not eliminate equipment grounding conductor bolted to outlet box.

END OF SECTION

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
1. Anchors, Threaded Rod and Fasteners
 2. Support Channel, Hangers and Supports
 3. Rooftop Conduit Supports

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
1. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
 2. Support systems to be supplied by a single manufacturer.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

- A. General: Provide conduit and equipment hangers and supports in accordance with the following:
1. When supports and anchorages for equipment conduit, cable tray and equipment are not shown on the Drawings, the Contractor is responsible for their design.
 2. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems: The following support systems to be designed, detailed, and bear the seal of a professional engineer registered in the State of Virginia.
1. Support frames such as conduit racks or stanchions for conduit and equipment which provide support from below.
 2. Equipment and piping support frame anchorage to supporting slab or structure.

- C. Provide channel support systems, for conduits to support multiple conduits capable of supporting combined weight of support systems and system contents.
- D. Provide heavy-duty steel trapezes for piping to support multiple conduit capable of supporting combined weight of supported systems and system contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Anchors, Threaded Rod and Fasteners:
 - 1. Anchor It
 - 2. Epcon System
 - 3. Hilti-Hit System
 - 4. Power Fast System
 - 5. Or approved equivalent.
- B. Support Channel, Hangers and Supports:
 - 1. B-Line
 - 2. Kindorf
 - 3. Superstrut
 - 4. Unistrut
 - 5. Or approved equivalent.
- C. Rooftop Conduit Supports:
 - 1. Cooper B-Line Dura-Block Rooftop Support Base
 - 2. Or approved equivalent.

2.2 ANCHORS, THREADED ROD AND FASTENERS

- A. Anchors, Threaded Rod and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Concrete Inserts: Cast in concrete for support fasteners for loads up to 800 lbs.
- C. Anchors and Fasteners:
 - 1. Do not use powder-actuated anchors.
 - 2. Concrete Structural Elements: Use precast inserts.
 - 3. Steel Structural Elements: Use beam clamps.
 - 4. Concrete Surfaces: Use self-drilling anchors.
 - 5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts.
 - 6. Solid Masonry Walls: Use expansion anchors.
 - 7. Sheet Metal: Use sheet metal screws.
 - 8. Wood Elements: Use wood screws.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.

- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

2.3 SUPPORT CHANNEL, HANGERS AND SUPPORTS

- A. Hangers and Supports - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
 - 1. Channel Material: Carbon steel.
 - 2. Coating: Hot dip galvanized.
- B. Pipe Straps: Two-hole galvanized or malleable iron.
- C. Luminaire Chain: 90 lb. test with steel hooks.
- D. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings that are necessary for completion of the project. The Contractor is responsible for their design.
 - 1. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- E. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- F. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- G. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

2.4 ROOFTOP CONDUIT SUPPORTS

- A. Curb base made of 100 percent recycled rubber and polyurethane prepolymer with a uniform load
- B. Capacity of 500 pounds per linear foot of support.
- C. UV resistant.
- D. Steel Frame: Steel, 14 gauge strut galvanized per ASTM A653 or 12 gauge strut galvanized per ASTM A653 for bridge series.
- E. Continuous block channel supports with 1-inch gaps to allow water flow, bridge channel supports, extendable height channel supports and elevated single conduit supports.
- F. Attaching Hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633 fastened directly into rubber material with weather resistant Type 12 lag screws.
- G. Provide load distribution plates when required for heavy loads.
- H. Finish: Black with safety yellow striping.
- I. Provide hot dipped galvanized components for items exposed to weather.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Fabrication - Miscellaneous Metals

1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
2. Finishes:
 - a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with one coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
 - b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
 - c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

3.2 ANCHORS, THREADED ROD AND FASTENERS INSTALLATION

- A. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.
- B. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- D. Do not use supports or fastening devices to support other than one particular item.
- E. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.
- F. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- G. Use spring lock washers under fastener nuts for strut.
- H. Cutting and Drilling
 1. Do not drill or cut structural members without prior permission from Architect.

3.3 SUPPORT CHANNEL, HANGERS AND SUPPORTS INSTALLATION

- A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
- B. Safety factor of 4 required for every fastening device or support for equipment installed. Supports to withstand four times the weight of equipment it supports.
- C. Verify mounting height of luminaires prior to installation when heights are not detailed.
- D. Install vertical support members for equipment and luminaires, straight and parallel to building walls.
- E. Install horizontal support members straight and parallel to ceilings or finished floor unless otherwise noted.
- F. Provide independent supports to structural member for luminaires, materials, or equipment installed in or on ceiling, walls or in void spaces or over suspended ceilings.
- G. Do not use other trade's fastening devices as supporting means for luminaires, equipment or materials.
- H. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- I. Do not use supports or fastening devices to support other than one particular item.
- J. Support conduits within 18-inches of outlets, boxes, panels, cabinets and deflections unless more stringently required by NEC.
- K. Maximum distance between supports not to exceed 8 foot spacing unless otherwise required by NEC.
- L. Support flexible conduits and metal clad cable within 12-inches of outlets, boxes, panels, cabinets and deflections unless otherwise required by NEC.
- M. Maximum distance between supports for flexible conduits and metal clad cable not to exceed 48-inches spacing unless otherwise required by NEC.
- N. Maximum distance between supports for rigid PVC conduits unless otherwise required by NEC is as follows:
 - 1. 1/2-inch or 3/4-inch and 1-inch conduit, 3-feet apart.
 - 2. 1-1/4-inch or 1-1/2-inch and 2-inch conduit, 4-feet apart.
 - 3. 2-1/2-inch and 3-inch conduit, 5-feet apart.
 - 4. 4-inch and 5-inch conduit, 6-feet apart.
 - 5. 6-inch conduit, 7-feet apart.
- O. Maximum distance between supports for auxiliary gutters and wireways unless otherwise required by NEC is as follows:
 - 1. Sheet metal auxiliary gutters and wireways - 4-feet apart horizontally and 10-feet vertically.
 - 2. Non-metallic auxiliary gutters and wireways - 30-inches apart horizontally and 3-feet vertically.
- P. Install strut hangers as instructed by strut manufacturer. Suspend strut hangers as instructed by strut manufacturer for the load, with a maximum spacing of 8-feet on center and within 2-feet of outlet box, cabinet, junction box or other channel raceway termination unless otherwise required by NEC.

- Q. Coordinate routing of conduit racks with materials and equipment installed by other trades. Where conduit racks are exposed to view, coordinate location and installation with Architect for optimal appearance.
- R. Securely suspend junction boxes, pull boxes or other conduit terminating housings located above suspended ceiling from floor above or roof structure to prevent sagging and swaying.
- S. Where service disconnects are mounted on building exterior, physically attach service disconnect to the building or structure served.
- T. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- U. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- V. Wet and Damp Locations:
 - 1. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1-inch off wall.

3.4 ROOFTOP CONDUIT SUPPORTS INSTALLATION

- A. Consult roofing manufacturer for roof membrane compression capacities. If necessary, provide a compatible sheet of roofing material (rubber pad) under rooftop support to disperse concentrated loads and add further membrane protection.
- B. Do not use supports that will void roof warranty.
- C. Install supports per manufacturer's instructions and recommendations.
- D. Use properly sized clamps to suit conduit sizes.
- E. Install supports for rooftop raceways to raise raceways a minimum of 7/8-inches above the roof structure unless otherwise noted.

END OF SECTION

SECTION 260533 - RACEWAYS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Rigid Metal Conduit (RMC)
 - 2. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Metal Conduit
 - 3. Electrical Metallic Tubing (EMT)
 - 4. Flexible Metal Conduit (FMC)
 - 5. Liquidtight Flexible Metal Conduit (LFMC)
 - 6. Electrical Polyvinyl Chloride (PVC) Conduit
 - 7. Conduit Fittings
- B. Provide a complete system of conduit and fittings, with associated couplings, connectors, and fittings, as shown on drawings and described in these specifications.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 05 29, Hangers and Supports for Electrical Systems and Equipment
 - 2. Section 26 05 34, Boxes

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.7 DEFINITIONS

- A. Raceway system is defined as consisting of conduit, tubing, duct, and fittings including but not limited to connectors, couplings, offsets, elbows, bushings, expansion/deflection fittings, and other components and accessories. Complete electrical raceway installation before starting the installation of conductors and cables.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Rigid Metal Conduit (RMC):

1. Allied Tube & Conduit
 2. Beck Manufacturing Inc.
 3. Picoma
 4. Wheatland Tube Company
 5. Or approved equivalent.
- B. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit:
1. Allied Tube & Conduit
 2. Thomas & Betts Corporation
 3. Robroy Industries
 4. O'kote Inc.
 5. Or approved equivalent.
- C. Electrical Metallic Tubing (EMT):
1. Allied Tube & Conduit
 2. Beck Manufacturing WL
 3. Picoma
 4. Wheatland Tube Company
 5. Or approved equivalent.
- D. Flexible Metal Conduit (FMC):
1. AFC Cable Systems Inc.
 2. Electri-Flex Company
 3. International Metal Hose
 4. Or approved equivalent.
- E. Liquidtight Flexible Metal Conduit (LFMC):
1. AFC Cable Systems Inc.
 2. Electri-Flex Company
 3. International Metal Hose
 4. Or approved equivalent.
- F. Electrical Polyvinyl Chloride (PVC) Conduit:
1. AFC Cable Systems Inc.
 2. Electri-Flex Company
 3. International Metal Hose
 4. JM Eagle
 5. Or approved equivalent.
- G. Conduit Fittings:
1. Bushings:
 - a. Insulated Type for Threaded Raceway Without Factory Installed Plastic Throat Conductor Protection:
 - 1) Thomas & Betts 1222 Series
 - 2) O-Z Gedney B Series
 - 3) Or approved Equivalent.
 2. Raceway Connectors and Couplings:
 - a. Thomas & Betts Series
 - b. O-Z Gedney Series
 - c. Or approved Equivalent.
 3. Expansion/Deflection Fittings:

- a. EMT: O-Z Gedney Type TX
 - b. RMC: O-Z Gedney Type AX, DX and AXDX, Crouse & Hinds XD
 - c. PVC: O-Z Gedney Type DX with PVC adapters, Carlon E945 Series, Kraloy OPEJ Series
 - d. Or approved equivalent.
- 2.2 RIGID METAL CONDUIT (RMC)
- A. UL 6, ANSI C80.1. Hot dipped galvanized steel conduit after thread cutting.
 - 1. Fittings: NEMA FB2.10.
- 2.3 POLYVINYL CHLORIDE (PVC) EXTERNALLY COATED GALVANIZED RIGID METAL CONDUIT
- A. Description: UL 6, ANSI C80.1, and NEMA RN 1; rigid steel conduit with external PVC coating.
 - 1. PVC Coating: Minimum 40 mils in thickness.
 - B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.
- 2.4 ELECTRICAL METALLIC TUBING (EMT)
- A. Description: UL 797, ANSI C80.3; steel galvanized tubing.
 - B. Fittings: NEMA FB 1; steel, compression type.
- 2.5 FLEXIBLE METAL CONDUIT (FMC)
- A. Description: UL 1, Interlocked steel construction.
 - B. Fittings: NEMA FB 2.20.
- 2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)
- A. Description: UL 360, inner core made from spiral wound strip of heavy gauge, hot dipped galvanized low carbon steel. 3/4-inch through 1-1/4-inch trade sizes to have a square lock core and contain an integral bonding strip of copper. 1-1/2-inch and larger to have fully interlocked core. Jacket material to be moisture, oil and sunlight resistant flexible PVC.
 - B. Fittings: NEMA FB 2.20.
- 2.7 ELECTRICAL POLYVINYL CHLORIDE (PVC) CONDUIT
- A. Description: UL 651, NEMA TC 2; Schedule 40 PVC.
 - B. Fittings: NEMA TC 3.
- 2.8 CONDUIT FITTINGS
- A. Bushings:
 - 1. Insulated type for threaded raceway connectors without factory-installed plastic throat conductor protection.
 - 2. Insulated grounding type for threaded raceway connectors.
 - B. Raceway Connectors and Couplings:
 - 1. Steel connectors, couplings, and conduit bodies, hot-dip galvanized.
 - 2. Connector locknuts to be steel, with threads meeting ASTM tolerances. Locknuts to be hot-dip galvanized.

3. Connector throats (EMT, flexible conduit, metal clad cable and cordset connectors) to have factory installed plastic inserts permanently installed. For normal cable or conductor exiting angles from raceway, the cable jacket or conductor insulation to bear only on plastic throat insert.
4. Steel gland, Tomic or Breagle connectors and couplings are recognized for this Contract as having acceptable raceway to fitting electrical conductance.
5. Set screw connectors and couplings, without integral compression glands, are recognized for this Contract as not having acceptable raceway to fitting electrical conductance. A ground conductor sized per this Specification must be included and bonded within raceway assembly utilizing this type connector or coupling.

C. Provide expansion/deflection fittings for EMT.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Finished Surfaces: Schedule raceway installation to avoid conflict with installed wall and ceiling surfaces. If unavoidable, coordinate work and repairs with Architect.
- B. Conduit Size:
 1. Minimum Size: 3/4-inch for power and control, unless otherwise noted. 3/4-inch for communication/data, unless otherwise noted. 3/4-inch for signal systems, unless otherwise noted.
- C. Underground Installations:
 1. More than 5-feet from Foundation Wall: Use PVC.
 2. Within 5-feet from Foundation Wall: Use PVC coated RMC.
 3. In or Under Slab on Grade: Use PVC.
 4. Minimum Size: 1-inch.
- D. In Slab Above Grade:
 1. Use PVC.
 2. Maximum Size Conduit in Slab: Contact Structural Engineer for maximum outside diameter of conduit.
- E. Provide two pull strings/tapes in empty conduits. Types:
 1. Feeders: Polyester measure/pulling tape, Greenlee 4436 or approved.
 2. Branch Circuits and Low Voltage: Greenlee Poly Line 431 or approved.
 3. If fish tape is used for pulling line or low voltage wiring, fiberglass type to be used. Metal fish tapes will not be allowed.
 4. Secure pull string/tape at each end.
 5. Provide caps on ends of empty conduit to be used in future.
 6. Label both ends of empty conduits with location of opposite end.
- F. Elbows: Use fiberglass or PVC coated RMC for underground installations.
- G. Elbow for Low Energy Signal Systems: Use long radius factory ells where linking sections of raceway for installation of signal cable.
- H. Verify that field measurements are as shown on drawings.
- I. Plan locations of conduit runs in advance of the installation and coordinate with ductwork, plumbing, ceiling and wall construction in the same areas.

- J. Locate penetrations and holes in advance where they are proposed in the structural sections such as footings, beams, and walls. Penetrations are acceptable only when the following occurs:
 - 1. Where shown on the structural drawings.
 - 2. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
- K. Verify routing and termination locations of conduit prior to rough-in.
- L. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.
- M. Install raceways securely, in neat and workmanlike manner, as specified in NECA 1, Standard Practices for Good Workmanship in Electrical Construction.
- N. Install steel conduit as specified in NECA 101, Standard for Installing Steel Conduits.
- O. Install nonmetallic conduit in accordance with manufacturer's instructions.
- P. Inserts, anchors and sleeves.
 - 1. Coordinate location of inserts and anchor bolts for electrical systems prior to concrete pour.
 - 2. Coordinate location of sleeves with consideration for other building systems prior to concrete pour.
- Q. Conduit Supports:
 - 1. Arrange supports to prevent misalignment during wiring installation.
 - 2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
 - 3. Group related conduits; support using conduit rack. Construct rack using steel channel. Provide space on each for 25 percent additional conduits.
 - 4. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
 - 5. Do not attach conduit to ceiling support wires.
- R. Flexible steel conduit length not-to-exceed 6-feet, 3-feet in concealed walls. Provide sufficient slack to reduce the effect of vibration.
- S. Install conduit seals at boundaries where ambient temperatures differ by 10 degrees F or more as shown on the drawings. Install seals on warm side of partition.
- T. Seal raceways stubbing up into electrical equipment. Plug raceways with conductors with duct-seal. Cap spare raceways and plug PVC raceway products with plastic plugs as made by Underground Products, or equal, shaped to fit snugly into the stubup.
- U. Seal raceways penetrating an exterior building wall to prevent moisture and vermin from entering into the electrical equipment.
- V. Use suitable caps on spare and empty conduits to protect installed conduit against entrance of dirt and moisture.
- W. Keep 277/480 volt wiring independent of 120/208 volt wiring. Keep power wiring independent of communication system wiring.
- X. Keep emergency system wiring independent of other wiring systems per NEC 700.
- Y. Arrange conduit to maintain headroom and present neat appearance.

- Z. Do not install conduits on surface of building exterior, along vapor barrier, across roof, on top of parapet walls, or across floors, unless otherwise noted on drawings.
- AA. Exposed conduits are permitted only in following areas:
1. Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished material.
 2. Existing walls that are concrete or block construction.
 3. Where specifically noted on Drawings.
 4. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.
- AB. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block area passage's intended usage.
- AC. Install continuous conduit and raceways for electrical power wiring and signal systems wiring.
- AD. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- AE. Maintain adequate clearance between conduit and piping.
- AF. Keep conduits a minimum of 12-inches away from steam or hot water radiant heating lines (at or above 104 degrees F) or 3-inches away from waste or water lines.
- AG. Cut conduit square using saw or pipecutter; deburr cut ends.
- AH. Bring conduit to shoulder of fittings; fasten securely.
- AI. Use conduit hubs to fasten conduit to cast boxes in damp and wet locations.
- AJ. Install no more than the equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams.
- AK. Use hydraulic one shot bender to fabricate elbows for bends in metal conduit larger than 2-inch size.
- AL. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- AM. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.
- AN. Conduit Terminations for Signal Systems: Provide a plastic bushing on the end of conduit used for signal system wiring.
- AO. Feeders: Do not combine or change feeder runs.
- AP. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.
- AQ. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation and installer.
- 3.2 RIGID METAL CONDUIT (RMC) INSTALLATION
- A. Outdoor Locations Above Grade: RMC.
 - B. Damp Locations: RMC.
 - C. In areas exposed to mechanical damage: RMC.
 - D. For security conduits installed exposed and subject to tampering: RMC.

- 3.3 POLYVINYL CHLORIDE (PVC) EXTERNALLY COATED GALVANIZED RIGID METAL CONDUIT INSTALLATION
- A. Use PVC coated RMC 36-inch radius ells for power service conduits and 48-inch radius ells for telephone service conduits.
- 3.4 ELECTRICAL METALLIC TUBING (EMT) INSTALLATION
- A. Dry Locations:
 - 1. Concealed: EMT.
 - 2. Exposed: EMT.
 - B. Dry, Protected: EMT.
- 3.5 FLEXIBLE METAL CONDUIT (FMC) INSTALLATION
- A. Dry Locations: Motors, recessed luminaires and equipment connections subject to movement or vibration, use flexible metallic conduit.
 - B. Install 12-inch minimum slack loop on flexible metallic conduit.
- 3.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) INSTALLATION
- A. Use PVC coated liquidtight flexible metallic conduit for motors and equipment connections subject to movement or vibration and subjected to any of following conditions: Exterior location, moist or humid atmosphere, corrosive environments, water spray, oil, or grease.
 - B. Install 12-inch minimum slack loop on liquidtight flexible metallic conduit.
- 3.7 ELECTRICAL POLYVINYL CHLORIDE (PVC) CONDUIT INSTALLATION
- A. Install in accordance with manufacturer's instructions.
 - B. Provide equipment grounding conductor in PVC conduit runs containing power conductors.
 - C. Underground Installation:
 - 1. Areas subject to vehicular traffic: Schedule 80 PVC.
 - 2. Other underground applications: Schedule 40 PVC, except where prohibited by the NEC or local codes.
 - D. Convert PVC conduit to Rigid Metal Conduit (RMC) prior to emerging from underground, concrete encasement, or concrete slab.
 - E. Provide expansion fittings to compensate for expansion and contraction per NEC 352.44.
 - F. PVC elbows are not acceptable. Use fiberglass or PVC coated RMC.
 - G. Trim cut ends inside and outside to remove rough edges.
 - H. Provide bushings when entering a box, fitting or other enclosure.
- 3.8 CONDUIT FITTINGS INSTALLATION
- A. Conduit Joints: Assemble conduits continuous and secure to boxes, panels, luminaires and equipment with fittings to maintain continuity. Provide watertight joints where embedded in concrete, below grade or in damp locations. Seal metal conduit with metal thread primer. Rigid conduit connections to be threaded, clean and tight (metal to metal). Threadless connections are not permitted for RMC.

- B. 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 20 minutes, minimum.
- C. Use set screw type fittings only in dry locations. When set screw fittings are utilized provide insulated continuous equipment ground conductor in conduit, from overcurrent protection device to outlet.
- D. Use compression fittings in dry locations, damp and rain-exposed locations. Maximum size permitted in damp locations and locations exposed to rain is 2-inches in diameter.
- E. Use threaded type fittings in wet locations, hazardous locations, and damp or rain-exposed locations where conduit size is greater than 2-inches.
- F. Use PVC coated, threaded type fittings in corrosive environments.
- G. Use insulated type bushings with ground provision at switchboards, panelboards, safety disconnect switches, junction boxes that have feeders 60 amperes and greater.
- H. Condulets and Conduit Bodies:
 - 1. Do not use condulets and conduit bodies in conduits for signal wiring, in feeders 100 amp and larger, or for conductor splicing.
- I. Sleeves and Chases - Floor, Ceiling and Wall Penetrations: Provide necessary rigid conduit sleeves, openings and chases where conduits or cables are required to pass through floors, ceilings or walls.
- J. Expansion Joints:
 - 1. Provide conduits crossing expansion joints where cast in concrete with expansion-deflection fittings, installed per manufacturer's recommendations.
 - 2. Secure conduits 3-inches and larger to building structure on opposite sides of a building expansion joint with an expansion-deflection fitting across joint installed per manufacturer's recommendations.
 - 3. Provide conduits less than 3-inches where not cast in concrete with junction boxes securely fastened on both sides of expansion joint, connected together with 15-inches of slack (minimum of 15-inches longer than straight line length) flexible conduit and copper green ground bonding jumper. In lieu of this flexible conduit, an expansion-deflection fitting, as indicated for conduits 3-inch and larger may be installed.
 - 4. Verify expansion/deflection requirements with Structural Engineer prior to installation.
- K. Provide rigid conduit coupling flush with surface of slab or wall for conduit stubbed in concrete slab or wall to serve electrical equipment or an outlet under table or to supply shop tool, etc. Provide plug where conduit is to be used in future.

END OF SECTION

SECTION 260534 - BOXES**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Outlet Boxes
 - 2. Floor Boxes and Poke-Thrus
 - 3. Pull and Junction Boxes
 - 4. Box Extension Adapter
 - 5. Weatherproof Outlet Boxes
- B. Provide electrical boxes and fittings for a complete installation. Include but not limited to outlet boxes, junction boxes, pull boxes, bushings, locknuts and other necessary components.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 05 33, Raceways
 - 2. Section 26 05 53, Identification for Electrical Systems

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Outlet Boxes:
 - 1. Hubbell
 - 2. Thomas & Betts
 - 3. Eaton/Crouse-Hinds
 - 4. Or approved equivalent.
- B. Floor Boxes and Poke-Thrus:
 - 1. Legrand (Wiremold)
 - 2. FSR
 - 3. Hubbell

4. Thomas & Betts
 5. MonoSystems
 6. Eaton/Crouse-Hinds
 7. Or approved equivalent.
- C. Pull and Junction Boxes:
1. Eaton/Crouse-Hinds
 2. Hoffman
 3. Or approved equivalent.
- D. Box Extension Adapter:
1. Hubbell
 2. Thomas & Betts
 3. Eaton/Crouse-Hinds
 4. Or approved equivalent.
- E. Weatherproof Outlet Boxes:
1. Legrand (Pass & Seymour)
 2. Hubbell
 3. Thomas & Betts
 4. Eaton/Crouse-Hinds
 5. Intermatic
 6. Or approved equivalent.

2.2 OUTLET BOXES

- A. Luminaire Outlet: 4-inch octagonal box, 1-1/2-inches deep with 3/8-inch luminaire stud if required. Provide raised covers on bracket outlets and on ceiling outlets.
- B. Device Outlet: Installation of one or two devices at common location, minimum 4-inches square, minimum 1-1/2-inches deep for non-USB type devices. Installation of one or two devices at common locations, minimum 4-inches square, minimum 2-inches deep for USB type devices. Single- or two-gang flush device raised covers.
- C. Telecom Outlet: Provide 4-inches square, minimum 2-1/8-inch deep box with two-gang plaster ring.
- D. Multiple Devices: Three or more devices at common location. Install one-piece gang boxes with one-piece device cover. Install one device per gang.
- E. Masonry Boxes: Outlets in concrete.
- F. Construction: For interior locations, provide galvanized steel outlet wiring boxes, of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices. All surface mounted outlet boxes are to be drawn. Welded boxes are not acceptable.
- G. Accessories: Provide outlet box accessories for each installation, including mounting brackets, wallboard hangers, extension rings, luminaire studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.
- H. Noise Control: Provide acoustic putty pad to back side of each outlet box installed in acoustic rated walls.

2.3 FLOOR BOXES AND POKE-THRUS

- A. Basis of Design: Floor boxes and poke-thrus are based on Legrand/Wiremold as the manufacturer. Manufacturers are approved for use on this project on condition of meeting or exceeding basis of design for conditions of use, box capacity, total allowed connecting conduit capacity, and available finishes. Products ordered or installed not meeting basis of design are subject to removal and replacement at no cost to Owner.
- B. Floor Boxes:
1. Multi-Gang Box, Slab on Grade: Cast iron housing rated for slab on grade application, fully adjustable, accepts up to 2-inch conduits. Rubber gasket protects interior from water and debris. 2-gang. Provide with 2 duplex receptacle(s) and activations for 2 telecom/AV outlets. Rectangular activation, flanged, for use with matching carpet or tile insert. Finish: aluminum. Legrand/Wiremold RFB2-OG or approved.
 2. Multi-Gang Box, Slab above Grade: Steel housing rated for fire rated slab above grade application, fully adjustable, accepts up to 2-inch conduits, fire rated for 2-hours. Rubber gasket protects interior from water and debris. 2-gang. Provide with 2 duplex receptacle(s) and activations for 2 telecom/AV outlets. Rectangular activation, flanged, for use with matching carpet or tile insert. Finish: aluminum. Legrand/Wiremold EFB45-FC or approved.
 3. Face-Up Floor Box, Slab on Grade: Cast-iron housing rated for slab on grade application, fully adjustable, accepts up to 1.25-inch for power and 2-inch for telecom. Rubber gasket protects interior from water and debris. 1-gang. Provide with 2 duplex receptacle(s) and activations for 2 telecom/AV outlets. Rectangular activation, flanged with Decora style flip cover. Finish: aluminum. Legrand/Wiremold 880CM series or approved.
 4. Face-Up Floor Box, Slab above Grade: Steel housing rated for fire rated slab above grade application, fully adjustable, accepts up to 1.25-inch for power and 2-inch for telecom, fire rated for 2-hours. Rubber gasket protects interior from water and debris. 1-gang. Provide with 2 duplex receptacle(s) and activations for 2 telecom/AV outlets. Rectangular activation, flanged with Decora style flip cover. Finish: aluminum. Legrand/Wiremold 8801S-FC series or approved.
- C. Poke-Thrus: Fire rated for up to 2 hr rated floors. Suitable for air handling spaces. Meets ADA accessibility guidelines. Exceeds UL scrub water exclusion requirements for tile, carpet and wood covered floors. Where used, devices recessed below floor level.
1. Cover Finish: Aluminum.
 2. Poke-thru for furniture feed for power and communications: One 0.75-inch and one 2-inch screw plug opening. Basis of Design: Legrand (Wiremold) 6ATCFF series or approved equivalent.
 3. Poke-thru with devices for 6-inch diameter core hole. Capacity for 2.5 gangs of power and communications devices. Prewired with two duplex receptacles. Basis of Design: Legrand (Wiremold) 6AT series or approved.
 4. Provide the following low voltage device mounting plates:
 - a. Decorator Style Basis of Design: Legrand (Wiremold) 6DEC.
 - b. Blank Basis of Design: Legrand (Wiremold) 6B.
 - c. Any additional accessories.

2.4 PULL AND JUNCTION BOXES

- A. Construction: Provide ANSI 49 gray enamel painted sheet steel junction and pull boxes, with screw-on covers; of type shape and size, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
- B. Location:
 - 1. Provide junction boxes above accessible ceilings for drops into walls for receptacle outlets from overhead.
 - 2. Provide junction boxes and pull boxes to facilitate installation of conductors and limiting accumulated angular sum of bends between boxes, cabinets and appliances to 270 degrees.
- C. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
 - 1. Construction: Galvanized cast iron.
 - 2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
 - 3. Cover Legend: ELECTRIC.
- D. Fiberglass Handholes: Die molded glass fiber hand holes:
 - 1. Cable Entrance: Pre-cut 6- x 6-inch cable entrance at center bottom of each side.
 - 2. Cover: Fiberglass weatherproof cover with nonskid finish.
 - 3. Cover Legend: ELECTRIC.

2.5 BOX EXTENSION ADAPTER

- A. Construction: Diecast aluminum.
- B. Location: Install over flush wall outlet boxes to permit flexible raceway extension from flush outlet to fixed or movable equipment.

2.6 WEATHERPROOF OUTLET BOXES

- A. Construction: Provide corrosion-resistant cast metal weatherproof outlet wiring boxes, of the type, shape and size, including depth of box, with threaded conduit ends, cast metal faceplate with spring-hinged waterproof cap suitably configured for each application, including faceplate, gasket, blank plugs and corrosion proof fasteners. Weatherproof boxes to be constructed to have smooth sides, gray finish.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate locations of floor boxes and wall mounted wiring device boxes with architectural and structural floor plans prior to rough-in.
- B. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1, Standard Practice of Good Workmanship in Electrical Construction.
- C. Secure boxes rigidly to substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
- D. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NEC. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.

- E. Set wall mounted boxes at elevations to accommodate mounting heights shown on Architectural Elevations.
- F. Electrical boxes are shown on drawings in approximate locations unless dimensioned.
 - 1. Adjust box locations up to 10-feet if required to accommodate intended purpose.
- G. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07, Thermal and Moisture Protection.
- H. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- J. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12-inches of box.
- K. Adjust boxes to be parallel with building lines. Boxes not plumb to building lines are not acceptable.
- L. Install knockout closures in unused box openings.
- M. Clean interior of boxes to remove dust, debris, and other material.
- N. Clean exposed surfaces and restore finish.

3.2 OUTLET BOXES INSTALLATION

- A. Mount outlet boxes, unless otherwise required by ADA, or noted on drawings, following distances above finished floor:
 - 1. Control Switches:
 - a. 48-inches to the top of outlet box.
 - b. 4-inches above top of backsplash at countertops/workstations, not-to-exceed 44-inches above finished floor to the top of outlet box per ADA requirements.
 - 2. Receptacles: 15-inches to the bottom of outlet box.
 - 3. Telecom Outlets: 15-inches to the bottom of outlet box.
 - 4. Other Outlets: As indicated in other sections of specifications or as detailed on drawings.
- B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.
- C. Flush Outlets in Insulated Spaces: Maintain integrity of insulation and vapor barrier.
- D. Coordinate electrical device locations and elevations (switches and receptacles) with architectural drawings to prevent mounting devices in mirrors, back splashes, and behind cabinets.
- E. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- F. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices. Adjacent boxes not aligned vertically to be adjusted at no additional cost to Owner.
- G. Use flush mounting outlet box in finished areas.
- H. Do not install flush mounting box back-to-back in walls; provide minimum 6-inches separation. Provide minimum 24-inches in acoustic rated walls.
- I. In acoustical walls, apply acoustic putty pad on outlet box prior to installation of acoustical blanket.

- J. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- K. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- L. Use adjustable steel channel fasteners for hung ceiling outlet box.
- M. Use gang box where more than one device is mounted together. Do not use sectional box.
- N. Use gang box with plaster ring for single device outlets.
- O. Adjust flush-mounting outlets to make front flush with finished wall material.

3.3 FLOOR BOXES AND POKE-THRUS INSTALLATION

- A. Use cast floor boxes for installations in slab on grade.
- B. Use steel boxes matching fire-rating of floor slab for slab above grade.
- C. Set floor boxes level.
- D. Adjust floor boxes flush with finish flooring material.
- E. Provide poke-thrus with fire rating equal to floor rating.
- F. Provide sufficient concrete cover around floor box to maintain fire rating of floor slab for slab above grade, and meet manufacturer installation directions for floor box on grade.

3.4 PULL AND JUNCTION BOXES INSTALLATION

- A. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- B. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6-inches from ceiling access panel or from removable recessed luminaire.
- C. Do not fasten boxes to ceiling support wires.
- D. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.5 BOX EXTENSION ADAPTER INSTALLATION

- A. Match material to box.
- B. Install gaskets at exterior and wet locations.

3.6 WEATHERPROOF OUTLET BOXES INSTALLATION

- A. Use cast outlet box in exterior locations exposed to weather and wet locations.
- B. Install gaskets.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Equipment Nameplates
 - 2. Device Labels
 - 3. Wire Markers

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals not required for this Section.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
 - 2. Manufacturer's standard products of categories and types required for each application as referenced in other Division 26, Electrical Sections. Where more than a single type is specified for application, provide single selection for each product category.
 - 3. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Equipment Nameplates:
 - 1. B & I Nameplates
 - 2. Intellicum
 - 3. JBR Associates
 - 4. Or approved equivalent.
- B. Device Labels:
 - 1. Kroy
 - 2. Brady
 - 3. Or approved equivalent.

- C. Wire Markers:
 - 1. Brady
 - 2. Panduit
 - 3. Sumitomo
 - 4. Or approved equivalent.

2.2 EQUIPMENT NAMEPLATES

- A. Engraved phenolic plastic, laminate, minimum 1/8-inch thick in the size indicated, with beveled edge border matching letter color. Federal specification L-P-387. All upper case letters in engraver standard letter style of the size and wording indicated. Punched for mechanical fastening, except where adhesive mounting is necessary due to substrate. Embossed tape style labels are not acceptable.
- B. Color:
 - 1. Normal (Utility): White letters on black background.
 - 2. Life Safety/Critical (Emergency Systems): Black letters on orange background.
 - 3. Equipment Branch (Legally Required Standby Systems): Black letters on yellow background.
- C. Letter Size:
 - 1. Use 1/2-inch letters minimum for identifying major equipment and loads, including switchgear, switchboards, etc.
 - 2. Use 1/4-inch or 1/2-inch letters minimum for identifying panels, breakers, etc.
 - 3. Use 3/16-inch minimum for identifying source, voltage, current, phase, and wire configurations.
- D. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- E. The Architect, Engineer, Commissioning Agent and Owner reserve the right to make modifications to the nameplates as necessary.
- F. Locations:
 - 1. Switchgear, switchboards, sub-distribution switchboards, distribution panels, and branch panels.
 - 2. Main breakers and distribution breakers in switchgear, switchboards, and distribution panels.
 - 3. Equipment including, but not limited to, motor controllers, disconnects, and VFDs.
 - 4. Low-voltage equipment enclosures including, but not limited to, fire alarm panels, access control panels, and lighting control panels.
 - 5. Distribution transformers.

2.3 DEVICE LABELS

- A. Extra strength, laminated adhesive tape, with 3/16-inch black letters on clear background. Use only for identification of individual wall switches and receptacles. Indicate device name, source panel, and source circuits. Panel and circuit designation written in permanent marker on the back of the plate and inside the back-box. Do not provide punch tape style labels.
- B. Label all junction boxes to show system identification, source circuit, or raceway origin. In finished areas, utilize device label. In unfinished areas or above ceilings, use of permanent ink marker is acceptable.

2.4 WIRE MARKERS

- A. Description: Vinyl-cloth self-adhesive type wire markers.
- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, junction boxes, and each load connection.
- C. Power and Lighting Circuits: Branch circuit or feeder number as indicated on drawings and source panel.
- D. Control Circuits: control wire number indicated on schematic and interconnection diagrams on drawings or shop drawings.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate designations used on Drawings with equipment nameplates and device labels.
- B. Install nameplates and labels parallel to equipment lines.
- C. Identify empty conduit and boxes with intended use.
- D. Provide typewritten branch panel schedules with protective clear transparent covers accounting for every breaker installed. Use actual room designations assigned by name or number near completion of the work, and not the designations shown on drawings.
- E. Provide color coded boxes as follows:
 - 1. Fire Alarm: Red.

3.2 EQUIPMENT NAMEPLATES

- A. Degrease and clean surfaces to receive nameplates.
- B. Secure equipment nameplates to equipment front using self-tapping stainless steel screws.
- C. Secure equipment nameplates to inside surface of door on panelboard that is recessed in finished locations.
- D. Verify emergency system distribution equipment nameplate colors with Architect/Owner.
- E. Switchgear, switchboards, and panels to include name source, voltage, current phase, wire configuration and fault current rating. Transformers to include source KVA, and secondary voltage, phase, and wire configuration.
- F. Provide nameplates for flush mounted branch panelboards identifying name on front door. On inside of door provide nameplate as noted above. Verify with Architect/Owner if nameplate on outside of door is required.
- G. Provide a second label at branch panelboards listing the means of identification of branch circuit conductors. This identification legend to consist of the color code used for each voltage system (208Y/120V and 480Y/277V). Include identification of both voltage systems on each label, regardless of the voltage of the panelboard to which the label is affixed. Comply with requirements of NEC 210.5.
 - 1. See Specification Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables, for required conductor color code for this project.

3.3 DEVICE LABELS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.

- C. Degrease and clean surfaces to receive labels.

3.4 WIRE MARKERS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide wire markers on each conductor for power, control, signalling and communications circuits.
- D. Where switches control remote lighting or power outlets, or where switches or outlets in same location serve different purposes, such as light, power, intercom, etc. or different areas, such as corridor and outside, provide plates with 1/8-inch black letters indicating function of each switch or outlet. Also label the function of light switches where two or more are mounted in same locations.

END OF SECTION

SECTION 260573 - ELECTRICAL DISTRIBUTION SYSTEM STUDIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Protective Devices
 - 2. Short Circuit Study
 - 3. Protective Device Study
 - 4. Selective Coordination Study
 - 5. Arc Flash Labels
 - 6. Arc Flash Risk Assessment
 - 7. Load-Flow and Voltage Drop Study
- B. Scope of Work: Provide short circuit analysis, selective coordination study, and load flow / voltage-drop analysis to provide the following:
 - 1. Settings for adjustable trip breakers;
 - 2. Arc flash labeling on panelboards and switchboards per NFPA 70E;
 - 3. Demonstrate with choice of overcurrent protection and trip settings that code-required selective coordination is provided for the emergency power branch and elevators.
 - 4. Transformer tap settings and feeder sizes for less than 2-percent voltage drop.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - 2. IEEE 399, Recommended Practice for Industrial and Commercial Power Systems Analysis.
 - 3. IEEE 1584, Guide for Performing Arc Flash Calculation.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition provide:
 - 1. Power system studies required under this Section with submittals for electrical equipment, including overcurrent protective devices.
 - 2. Electrical equipment ordered prior to submittal of power system studies are not compliant with these specifications, and are subject to removal and replacement at no cost to Owner where not in compliance with Code and Contract Documents for selective coordination.
 - a. Provide written verification with Stamp or Seal and signature of preparing Engineer.
 - 3. Provide samples of NFPA 70E compliant arc flash hazard labeling for electrical equipment.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Study Preparer Qualifications: Qualified engineer of switchgear manufacturer or approved professional engineer.
 - a. Experienced in preparation of studies of similar type and magnitude.
 - b. Familiar with software analysis products specified.
 - 2. Computer Software for Study Preparation: Use latest edition of commercially available software utilizing specified methodologies.
 - a. Acceptable Software Products:
 - 1) EasyPower
 - 2) Operation Technology, Inc; ETAP.
 - 3) SKM Systems Analysis, Inc; Power Tools for Windows.
 - 3. Contractor Responsibility: Provide project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, actual circuit lengths and available fault currents from utility. Provide information in a timely matter to allow studies to be completed prior to release of equipment.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Analyze specific electrical and utilization equipment (according to NEC definition), actual protective devices to be used, and actual feeder lengths to be installed.
 - 1. Scope of Studies: New and existing distribution wiring and equipment, from primary source to buses and branch circuit panelboards.
 - 2. Primary Source, for Purposes of Studies: Utility company primary protective devices.
 - 3. Study Methodology: Comply with requirements and recommendations of NFPA 70, IEEE 399, and IEEE 242.
 - 4. Report: State methodology and rationale employed in making each type of calculation; identify computer software package(s) used.
- B. One-Line Diagrams: Prepare schematic drawing of electrical distribution system, with electrical equipment and wiring to be protected by protective devices; identify nodes on diagrams for reference on report that includes:
 - 1. Calculated fault impedance, X/R ratios, utility contribution, and short circuit values (asymmetric and symmetric) at main switchboard bus and downstream devices containing protective devices.
 - 2. Breaker and fuse ratings.
 - 3. Generator kW and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 - 4. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 - 5. Identification of each bus, with voltage.

6. Conduit materials, feeder sizes, actual lengths, and X/R ratios.

2.2 PROTECTIVE DEVICES

- A. Provide protective devices of ratings and settings as required so that protective device closest to fault will open first.
- B. Replace existing protective devices to achieve specified performance.
- C. Analyze and determine ratings and settings of protective devices to minimize damage caused by fault and so that protective device closest to fault will open first.
 1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
 2. Motors with Solid-State Protective Modules: Select settings for best possible motor protection, taking into consideration actual installed motor torque and current and thermal characteristics.
 3. Identify any equipment that is underrated as specified.
 4. Identify specified protective devices that will not achieve required protection or coordination but with minor changes can be made to do so; provide such modified devices at no additional cost to Owner and identify them on submittals as "revised in accordance with Protective Device Coordination Study"; minor changes include different trip sizes in same frame, time curve characteristics of induction relays, CT ranges, etc.
 5. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve change to contract sum.
 6. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Owner, provide a discussion of alternatives and logical compromises for best achievable coordination.
 7. Do not order, furnish, or install protective devices that do not meet performance requirements unless specifically approved by Engineer.
- D. Protective Device Rating and Setting Chart: Summarize in tabular format required characteristics for each protective device based on analysis; include:
 1. Device identification.
 2. Relay CT ratios, tap, time dial, and instantaneous pickup.
 3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
 4. Fuse rating and type.
 5. Ground fault pickup and time delay.
 6. Input level and expected response time at two test points that are compatible with commonly available test equipment and ratings of protective device.
 7. Highlight devices that as furnished by Contractor will not achieve required protection.
- E. Specified equipment has been designed and selected to achieve specified performance; ensure that equipment actually installed provides that performance.
- F. In addition to requirements specified elsewhere, provide overcurrent protective devices having ratings and settings in accordance with results of system studies.

2.3 SHORT CIRCUIT STUDY

- A. Calculate fault impedance to determine available 3-phase short circuit and ground fault currents at each bus and piece of equipment during normal conditions, alternate operations, emergency power conditions, and other operations that could result in maximum fault conditions.
 - 1. Show fault currents available at key points in system down to fault current of 1,000 A at 480 V and 208 V.
 - 2. Include motor contributions in determining momentary and interrupting ratings of protective devices.
 - 3. Primary Fault Level Assumptions: Obtain data from utility company.

2.4 PROTECTIVE DEVICE STUDY

- A. Analyze and determine ratings and settings of protective devices to minimize damage caused by fault and so that protective device closest to fault will open first.
 - 1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
 - 2. Motors with Solid-State Protective Modules: Select settings for best possible motor protection, taking into consideration actual installed motor torque and current and thermal characteristics.
 - 3. Identify any equipment that is underrated as specified.
 - 4. Identify existing protective devices that will not achieve required coordination and cannot be field adjusted to do so.
 - 5. Identify specified protective devices that will not achieve required protection or coordination but with minor changes can be made to do so; provide such modified devices at no additional cost to Owner and identify them on submittals as "revised in accordance with Protective Device Coordination Study"; minor changes include different trip sizes in same frame, time curve characteristics of induction relays, CT ranges, etc.
 - 6. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve change to contract sum.
 - 7. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Owner, provide a discussion of alternatives and logical compromises for best achievable coordination.
 - 8. Do not order, furnish, or install protective devices that do not meet performance requirements unless specifically approved by Architect.
- B. Protective Device Rating and Setting Chart: Summarize in tabular format required characteristics for each protective device based on analysis; include:
 - 1. Device identification.
 - 2. Relay CT ratios, tap, time dial, and instantaneous pickup.
 - 3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
 - 4. Fuse rating and type.
 - 5. Ground fault pickup and time delay.
 - 6. Input level and expected response time at two test points that are compatible with commonly available test equipment and ratings of protective device.

7. Highlight devices that as furnished by Contractor will not achieve required protection.

2.5 SELECTIVE COORDINATION STUDY

- A. For all emergency, legally required standby and critical operations systems over current devices, perform an organized time-current analysis of each protective device in series from individual device back to source, under normal and emergency power conditions.
 1. Graphically illustrate that adequate time separation exists between series devices, including upstream primary device.
 2. Plot specific time-current characteristics of each protective device on log-log paper.
 3. Organize plots so that upstream devices are clearly depicted on one sheet.
 4. Also show following on curve plot sheets:
 - a. Device identification.
 - b. Voltage and current transformer ratios for curves.
 - c. 3-phase and 1-phase ANSI damage curves for each transformer.
 - d. No-damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum short circuit cutoff point.
 - h. Simple one-line diagram for portion of system that each curve plot illustrates.
 - i. Software report for each curve plot, labeled for identification.
- B. Devices to coordinate down to 0.01 seconds. Coordination required for emergency systems, legally required systems, and elevators.

2.6 ARC FLASH LABELS

- A. Provide label compliant with NFPA 70E guidelines indicating personal protective equipment (PPE) recommended for servicing of electrical equipment while energized, as well as calculated incident energy levels and arc flash protective boundary distance.

2.7 ARC FLASH RISK ASSESSMENT

- A. Calculate arc flash incident energy (AFIE) levels and flash protection boundary distances to determine required level of personal protective equipment (PPE) at each bus and piece of equipment during normal conditions, emergency power conditions, and other operations that could result in maximum arc flash incident energy levels.
 1. Show flash protection boundary distance.
 2. Include incident energy levels.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Provide services of qualified field engineer and necessary tools and equipment to test, calibrate, and adjust installed protective devices to conform to requirements determined by coordination analysis.
- B. Adjust installed protective devices having adjustable settings to conform to requirements determined by coordination analysis.
- C. Submit report showing final adjusted settings of protective devices.

3.2 ELECTRICAL POWER SYSTEM STUDIES

- A. Short Circuit Analysis Study:

1. Provide complete short circuit study, equipment interrupting and withstand evaluation. Study to include complete electrical distribution system, including contributions from normal source of power without alternative sources of power. Include complete low voltage distribution systems as specified in this Section.
 2. Study Basis: thoroughly cover normal and alternative operation modes that can produce maximum fault conditions, including simultaneous motor contributions.
 3. Perform study in accordance with applicable ANSI/IEEE Standards.
 4. Study Input Data: Utility company short circuit single and three phase contribution, and X/R ratio; resistance and reactance components of each feeder, busway and branch impedance; motor and generator contributions; applicable circuit parameters and contribute to short circuit duty.
 5. Calculate short circuit momentary duties and interrupting duties on basis of maximum available fault current at each switchgear bus, switchboard, motor control center, panelboards, transfer switches, busway plug connection point, dry-type transformer primary and secondary locations, other significant locations throughout system affected by available fault current (including large HVAC units, uninterruptible power supplies, etc.).
 6. Perform equipment evaluation study to determine adequacy of overcurrent protection devices by tabulating and comparing short circuit ratings of these devices with available fault current. Notify Owner in writing where problem areas or inadequacies appear in electrical equipment.
 7. Study Report: In bound final report, include sheets listing tabulated information from study, including feeder impedances, motor, utility and generator impedances and fault contributions, and resulting short circuit current including asymmetrical, symmetrical, three, five and eight cycle fault current levels, and line-to-neutral and three-phase-bolted-fault current levels at each calculated point in electrical distribution system.
- B. Protective Device Study:
1. Perform time-current coordination analysis with aid of computer software intended for this purpose. Include determination of settings, ratings, or types for overcurrent protective devices supplied.
 2. Where necessary, make an appropriate compromise between system protection and service continuity with service continuity considered more important than system protection.
 3. Provide sufficient number of computer generated log-log plots to indicate degree of system protection and coordination by displaying time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
 4. Computer printouts accompany log-log plots and will contain descriptions for each of devices shown, settings of adjustable devices, short-circuit current availability at device location when known, and device identification numbers to aid in locating devices on log-log plots and system one-line diagram.
 5. Study includes separate, tabular computer printout containing suggested device settings of adjustable overcurrent protective devices, equipment where device is located, and device number corresponding to device on system one-line diagram.
 6. Provide computer generated system one-line diagram which clearly identifies individual equipment buses, bus numbers, device identification numbers and maximum available short-circuit current at each bus when known.

7. Discussion Section which evaluates degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
 8. Call significant deficiencies in protection and/or coordination to attention of Engineer and recommendations made for improvements as soon as they are identified.
 9. Contractor responsible for supplying pertinent electrical system conductor, circuit breaker, generator, and other component and system information in timely manner to allow time-current analysis to be completed prior to final installation.
- C. Selective Coordination Study:
1. Perform time-current coordination analysis with aid of computer software intended for this purpose. Include determination of settings, ratings, or types for overcurrent protective devices supplied.
 2. Where necessary, make an appropriate compromise between system protection and service continuity with service continuity considered more important than system protection.
 3. Provide sufficient number of computer generated log-log plots to indicate degree of system protection and coordination by displaying time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
 4. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 - b. Terminate device characteristic curves at a point reflecting maximum symmetrical fault current to which the device is exposed.
 - c. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 - d. No more than 5 devices per TCC.
 - e. Plot the following listed characteristic curves, as applicable:
 - 1) Power 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) Cables and conductors damage curves.
 - 7) Ground-fault protective devices.
 - 8) Generator short-circuit decrement curve and generator damage point.
 - 9) The largest feeder circuit breaker in each motor-control center and panelboard.
 5. Study includes separate, tabular computer printout containing suggested device settings of adjustable overcurrent protective devices, equipment where device is located, and device number corresponding to device on system one-line diagram.

6. Provide computer generated system one-line diagram which clearly identifies individual equipment buses, bus numbers, device identification numbers and maximum available short-circuit current at each bus when known.
 7. Discussion Section which evaluates degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
 8. Call significant deficiencies in protection and/or coordination to attention of Engineer and recommendations made for improvements as soon as they are identified.
 9. Contractor responsible for supplying pertinent electrical system conductor, circuit breaker, generator, and other component and system information in timely manner to allow time-current analysis to be completed prior to final installation.
- D. Arc Flash Risk Assessment:
1. Perform arc flash risk assessment with aid of computer software intended for this purpose.
 2. Perform arc flash risk assessment in conjunction with short-circuit analysis and time-current coordination analysis.
 3. Submit results of assessment in tabular form, and include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
 4. Perform analysis under worst-case arc flash conditions, and final report describes, when applicable, how these conditions differ from worst-case bolted fault conditions.
 5. Arc flash risk assessment includes recommendations for reducing AFIE levels and enhancing worker safety.
 6. Proposed vendor demonstrates experience with arc flash risk assessment by submitting names of at least ten actual arc flash risk assessments it has performed in past year.
 7. Proposed vendor demonstrates capabilities in providing equipment, services, and training to reduce arc flash exposure and train workers in accordance with NFPA 70E and other applicable standards.
 8. Proposed vendor demonstrates experience in providing equipment labels in compliance with NEC and ANSI Z535.4 to identify AFIE and appropriate Personal Protective Equipment classes.
- E. Load-Flow And Voltage Drop Study:
1. Perform a load-flow and voltage drop study to determine the steady state loading profile of the system. Determine load-flow and voltage drop based of full load current shown in the design. The model should include all loads indicated in the panel schedules, one-line diagram, and equipment connection schedules, as applicable.
 2. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded; indicate voltage drop for all buses in the system.
 3. Provide recommendations for areas that have voltage drop values higher than 2-percent for feeders.
 4. Indicate the recommended fixed transformer taps that might be used to solve the voltage drop issues.

END OF SECTION

SECTION 260923 - OCCUPANCY AND VACANCY SENSORS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Occupancy/Vacancy Sensors (Ceiling Mounted)
 - 2. Combined Occupancy Sensor/Wall Switches ("Sensor/Switches")
 - 3. Automatic Switches

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Provide wiring diagrams indicating low voltage and line voltage wiring requirements.
 - 2. Provide, on reproducible architectural floor plan, a layout of sensors indicating their sensing distribution.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Use manufacturer's published testing and adjusting procedures to adjust sensors time delay, daylight sensitivity, and passive infrared sensitivity to satisfaction of the Owner.
 - 2. Prepare and complete report of test procedures and results. Submit these test procedures and results to Owner and Architect.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Occupancy/Vacancy Sensors (Ceiling Mounted):
 - 1. Passive Infrared Occupancy/Vacancy Sensors:
 - a. Acuity Controls
 - b. WattStopper
 - c. Leviton
 - d. Hubbell
 - e. Greengate

- f. Or approved equivalent.
2. Ultrasonic Occupancy/Vacancy Sensors:
 - a. WattStopper
 - b. Leviton
 - c. Hubbell
 - d. Greengate
 - e. Acuity Controls
 - f. Or approved equivalent.
3. Dual Technology Occupancy/Vacancy Sensors:
 - a. WattStopper
 - b. Leviton
 - c. Hubbell
 - d. Greengate
 - e. Acuity Controls
 - f. Or approved equivalent.
- B. Combined Occupancy/Vacancy Sensor:
 1. Lutron
 2. Acuity Controls
 3. WattStopper
 4. Leviton
 5. Hubbell
 6. Greengate
 7. Or approved equivalent.
- C. Automatic Switches:
 1. Acuity Controls
 2. WattStopper
 3. Leviton
 4. Hubbell
 5. Greengate
 6. Or approved equivalent.
- D. Basis of Design: Occupancy/Vacancy sensor layout on Drawings are designed based on WattStopper product line. Approved manufacturers listed are allowed on condition of meeting the specified conditions including complete sensor coverage of the area controlled and switching of luminaires in the area controlled. Provide additional sensors and power switch packs as needed to provide the same level of functionality as shown on Drawings or required in Specifications. Remove and replace electrical equipment installed not meeting these conditions at no cost to Owner.

2.2 GENERAL

- A. Occupancy sensor designation indicates sensors automatically turn lights ON when the sensor detects the presence of a person and will automatically turn lights OFF when no presence is detected for a specified amount of time (automatic-on and automatic-off).
- B. Vacancy sensor designation requires someone to manually turn the lights ON. The sensor will then automatically turn the lights OFF when no presence is detected for a specified amount of time (manual-on and automatic-off).

- C. Provide occupancy sensors to sense presence of human activity within desired space and enable or disable on/off manual lighting control function provided by local switches.
- D. Upon detection of human activity by detector, sensor initiates time delay to maintain lights on for present period of time. Field adjustable time delay setting from 30 seconds to 15 minutes.
- E. Factory set sensors for maximum sensitivity.
- F. LED lamp built into sensor indicates when occupant is detected.
- G. Provide zero cross relay control with sensors and sensor/switched; relay contacts close and open with AC voltage signal is at zero.
- H. Where line voltage sensors and sensor/switches are used, provide to match voltage of controlled circuit.
- I. Line Voltage Sensors, Control Units, and Relays: UL listed.

2.3 OCCUPANCY/VACANCY SENSORS (CEILING MOUNTED)

- A. Passive Infrared Sensors:
 - 1. Sensor Function: Detects human presence in floor area being controlled by detecting changes in Infrared energy. Sensor detects small movements, i.e., when people are writing while seated at a desk.
 - 2. Provide temperature compensated dual element pyro-electric sensor and with multi element Fresnel lens.
 - 3. Sensor utilizes DIP switches for adjustment to time delay and override. Field adjustable settings for sensitivity.
 - 4. Provide daylight filter to ensure that sensor is insensitive to short-wavelength infrared waves, i.e., those emitted by sun.
 - 5. Adjustments and mounting hardware under removable cover to prevent tampering with adjustments and hardware.
 - 6. Sensor utilizes advanced digital signal processing technology to reduce false offs without reducing sensitivity.
 - 7. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. 360 degree sensor range; coverage: 1200 SF, unless otherwise noted on drawings.
 - c. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper CI-300 Series.
 - 8. Building Exterior Sensor:
 - a. Capable of mounting on walls, eaves or ceilings.
 - b. On/off control based on daylight levels via adjustable light level setting.
 - c. Line Voltage: provide sensor to match voltage of lighting controlled; capable of switching up to 1000 watts ballast and incandescent load.
 - d. Adjustable time delay from 15 seconds to 15 minutes.
 - e. Silicon gasketed to prevent water and dust intrusion. UL listed raintight.
 - f. Rated to operate in temperatures from -40 degrees F to 130 degrees F.
 - g. Provide each sensor with manufacturer supplied wire-guard.
 - h. Provide isolated relay for monitoring by security system

- i. Coverage:
 - 1) Narrow beam up to 100 foot distance.
 - 2) 90 degree beam up to 50 foot distance.
 - j. Finish: White.
 - k. Basis of Design: Wattstopper EN Series.
 - l. Parking Lot Lighting Control:
 - 1) On/off control based on daylight levels via adjustable light level setting.
 - 2) Low Voltage Sensor: 24VDC power. Sensor operates luminaire high/low control.
 - 3) Adjustable time delay from 15 seconds to 15 minutes.
 - 4) Silicon gasketed to prevent water and dust intrusion. UL listed raintight.
 - 5) Rated to operate in temperatures from -40 degrees F to 130 degrees F.
 - 6) Sensor front rotates and pivots for coverage adjustment after installation.
 - 7) Basis of Design: Wattstopper EW Series
- B. Ultrasonic Occupancy/Vacancy Sensors:
- 1. Sensor Function: Detects human presence in controlled floor area by detecting Doppler shifts in 40kHz ultrasound created by sensor.
 - 2. Sensors are precision crystal controlled and do not interfere with each other when two or more are placed in same area. Sensor includes advanced digital signal processing to reduce false on signals without decreasing sensitivity, as well as immunity to RFI/EMI sources.
 - 3. Sensor utilizes DIP switches for adjustment to time delay and override. Field adjustable settings for sensitivity.
 - 4. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 - 5. Provide adjustments and mounting hardware under removable cover to prevent tampering.
 - 6. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. Maximum protrusion of 1.1-inches and blend in aesthetically with ceiling.
 - c. Coverage: 360 degree sensor range; coverage: 2,000 SF, unless otherwise noted on Drawings.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper WT Series.
 - 7. Ceiling Mounted Sensor - Hallway Sensor Coverage:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. Maximum protrusion of 1.5-inches and blend in aesthetically with ceiling.
 - c. Coverage: 90 linear feet.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper UT-300-3 Series.
- C. Dual Technology Sensors:
- 1. Sensor Function: Combined capability of passive infrared with ultrasonic or microphonic technology as described above.

2. Function: Upon a person entering a space, motion must be sensed by both technologies before lighting will be turned on. After this has occurred, detection by either technology will hold lighting on. Sensors retrigger time delay where only one motion is necessary to turn on lights within 5 seconds after turning off.
3. Ceiling-Mounted Sensor:
 - a. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 - b. 360 degree sensor range; coverage: 1000 SF for half-step motion, unless otherwise noted on Drawings.
 - c. Low Voltage Sensor: 24VDC power. Sensor operates remote power switch packs. Multiple sensors can be wired in parallel allow coverage of large areas.
 - d. Provide internal form C dry contacts for HVAC control.
 - e. Basis of Design: Wattstopper DT-300 Series.

2.4 COMBINED OCCUPANCY/VACANCY SENSOR/WALL SWITCHES ("SENSOR/SWITCHES")

- A. Completely self-contained sensor system that fits into standard single gang box. Internal transformer power supply, latching dry contact relay switching mechanism compatible with electronic ballasts, compact fluorescent, and inductive loads. Triac and other harmonic generating devices are not allowed.
- B. Passive infrared sensor technology includes advanced signal processing to reduce false triggers without increasing sensitivity. LED indicator blinks when occupant sensed.
- C. Rated to switch loads: 800 watts incandescent or 120-volt ballast; 1000 watts 277 volt ballast. Zero-crossing technology switches lighting off when AC voltage is at zero, minimizes contact wear.
- D. Provide adjustable daylight feature that holds lighting "off" when desired footcandle level is present.
- E. Provide integral off override switch with no leakage current to load or ground.
- F. Vandal-resistant lens.
- G. Includes neutral wire to meet NEC.
- H. Finish: White.
- I. Alerts for impending shut-off: light flash, audible, both or none.
- J. Standard Sensor/Switch:
 1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off). Factory set to manual on/auto off.
 2. 180 degree sensor range; coverage: 150 SF for desktop activity.
 3. Basis of Design: Wattstopper PW-301 Series.
- K. Dual Relay Sensor/Switch:
 1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
 2. Dual auto-off buttons on face of switch allow end-user to turn off two switch legs in room space. Built-in light adjustable level sensor only turns off second of two relays when desired footcandle level is present. Otherwise similar to specifications above for single-zone sensor/switch.
 3. Defaults to Manual-ON to 50% operation for maximum energy savings.

4. 180 degree sensor range; coverage: 150 SF for desktop activity.
5. Finish: White.
6. Basis of Design: Wattstopper PW-302.

L. Sensor/Slide Dimmer:

1. Line voltage slider dimmer allows for manual adjustment of lighting levels from 100 percent to 10 percent; compatible with two-wire line voltage 100 percent to 10 percent electronic dimming ballasts. Separate manual button for override 'off' control.
2. 180 degree sensor range; coverage: 300 SF for desktop activity.
3. Basis of Design: Wattstopper PW-100D/101D Series.

M. Passive Infrared Wall Switch Vacancy-Only Sensors:

1. Operates only as a vacancy sensor (manual-on and automatic-off).
2. Adjustable sensitivity (high, low presets).
3. Basis of Design: Lutron Maestro MS Series.

N. Dual Technology Wall Switch Vacancy-Only Sensors:

1. Operates only as a vacancy sensor (manual-on and automatic-off).
2. Adjustable sensitivity (high, medium, low, and off presets) individually for passive infrared and ultrasonic sensing.
3. Basis of Design: Lutron Maestro MS Series.

O. Passive Infrared Wall Dimmer Vacancy-Only Sensors:

1. Operates only as a vacancy sensor (manual-on and automatic-off).
2. Basis of Design: Lutron Maestro MSCL Series.

P. Passive Infrared 0-10 V Wall Dimmer Vacancy-Only Sensors:

1. Operates only as a vacancy sensor (manual-on and automatic-off).
2. Basis of Design: Lutron Maestro 0-10V Dimmer Sensor MS Series.

2.5 AUTOMATIC SWITCHES

A. Automatic ("Sentry") Switch:

1. Programmable to operate as an occupancy sensor (automatic-on and automatic-off) or a vacancy sensor (manual-on and automatic-off).
2. Controls up to 1800 watts at 120-volt, 4100-watts at 277-volt, suitable for ballast and motor loads.
3. Compatible with Decora style faceplate.
4. Zero crossing circuitry.
5. Finish: Match wiring devices unless selected otherwise by Architect.
6. Capable of being connected with other sentry switches to produce 3 and 4 way switching.
7. Based on power interruptions of following durations from an upstream control panel, produces following effects:
 - a. 5 Seconds: Turns lighting off with no delay.
 - b. 3 Seconds: Turns lighting on with no delay.
 - c. 1 to 2 Seconds: Delayed off. Blinks lights and provides audible signal to room occupant. If switch push button is not pressed within 5 minutes, lights are turned off.
8. Basis of Design: Wattstopper AS-100 Series.

B. Digital Timer Switch:

1. Controls up to 1800 watts at 120 volt, 4100 watts at 277 volt, suitable for ballast and motor loads.
2. Compatible with Decora style faceplate.
3. Provide low voltage (24VAC/VDC) version where used as input to lighting relay panel; includes single-pole, double-throw isolated relay rated for 1A at 30VDC.
4. Electroluminescent LCD display shows timer countdown.
5. Time out setting range from 5 minutes to 12 hours. Lights can be turned off before time-out setting by holding down on/off button.
6. Timer countdown can be reset to beginning by holding down push button for 2 seconds.
7. Zero crossing circuitry.
8. Finish: White.
9. Room lighting flashed and switch beeps 5 minutes and 1 minute prior to switching room lighting off. Either visible or audible features can be disabled.
10. Basis of Design: Wattstopper TS-400 Series.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install occupancy/vacancy sensors as directed by manufacturer's instructions. Complete connections to control circuits, occupancy sensors, power supply pack and low voltage wiring.
- B. Provide power packs for sensor to control number of circuits and/or switch legs within its area of coverage.
- C. Field adjust each sensor to maximize its coverage of room space.
- D. Relocate sensors with ultrasonic technology to avoid being closer to HVAC diffusers and power packs than recommended by manufacturer.
- E. Field set time delay for each device as noted below:
 1. Restrooms: 15 minutes.
 2. Storage Rooms, Janitor's Closets, Unisex Restrooms: 5 minutes.
 3. All Other Spaces: 15 minutes.
 4. Time Switches: 2-hours.
- F. Coordinate HVAC control requirements with controls contractor prior to installation.
- G. Lighting System Testing and Commissioning:
 1. Test lighting controls to ensure that control devices, components, equipment and systems are calibrated, adjusted and operate in accordance with Drawings and Specifications. Provide functional testing of sequences of operation to ensure operation in accordance with Drawings and Specifications. Provide complete report of test procedures and results to engineer and insert approved copy into project closeout documents.
 2. Testing includes:
 - a. Daylight Automatic Controls
 - b. Occupant Sensing Automatic Controls
 - c. Automatic Time and Override Controls for Interior Lighting
 - d. Automatic Time and Photo Controls for Exterior Lighting

END OF SECTION

SECTION 262416 - PANELBOARDS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Power Distribution Panelboards
 - 2. Panelboards

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 05 73, Electrical Distribution System Studies.
 - 2. Section 26 24 13, Switchboards.
 - 3. Section 26 28 00, Overcurrent Protective Devices.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. UL 67, Standards for Panelboards.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Power Distribution Panelboards:
 - 1. Eaton
 - 2. ABB/General Electric
 - 3. Siemens
 - 4. Schneider Electric/Square D
 - 5. Or approved equivalent.
- B. Panelboards:
 - 1. Eaton
 - 2. ABB/General Electric
 - 3. Siemens
 - 4. Schneider Electric/Square D

5. Or approved equivalent.

- C. Manufacturers listed above are allowed on condition of meeting specified conditions including available space for equipment, Code required working clearances, selective coordination per Section 260573, Electrical Distribution System Studies, and amps interrupting capacity (AIC) per short circuit study in Section 260573, Electrical Distribution System Studies. Prior to submitting bid, manufacturer to provide documentation to Engineer verifying specific conditions, including those mentioned above, can be met. Remove and replace electrical equipment installed, at no cost to the Owner, that does not meet these conditions.

2.2 POWER DISTRIBUTION PANELBOARDS

- A. Description: NEMA PB 1 Type 1 or as indicated on drawings, circuit breaker type.
- B. Integrated Equipment Rating: Provide fully rated integrated equipment rating greater than the available fault current. Series rated panelboards are not acceptable. Reference drawings for available fault currents. If drawings do not have available fault current shown, then coordinate with serving electrical utility. Final rating based on the protective device study completed under the provisions of Division 26, Electrical Distribution System Studies.
- C. Panelboard Bus: Non-reduced aluminum, ratings as indicated on drawings. Bus bar with suitable electroplating (tin) for corrosion control at connection. Provide copper ground bus in each panelboard.
- D. Lugs: Mechanical type for both aluminum and copper conductors. All device terminals/lugs shall be rated for a minimum of 75 degrees C to facilitate the use of 75 degrees C conductor ampacity rating.
- E. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.
- F. Molded Case Circuit Breakers with Current Limiters: With replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole; UL listed.
- G. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- H. Circuit Breakers 1200 Amp and Greater: Provide breaker with energy-reducing maintenance switching with local status indicator per NEC Article 240.87(B).
- I. Fully equip unused spaces for future devices, including manufacturer required connections and mounting hardware.
- J. Cabinet Front: Surface type hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.3 PANELBOARDS

- A. Description: Panelboards 400 amps or less. NEMA PB1, Type 1 or as indicated on drawings, circuit breaker type. Maximum enclosure depth: 6-inches for surface mounted, 5-3/4-inches for flush mounted.
- B. Maximum Width: 20-inches.
- C. Integrated Equipment Rating: Provide fully rated integrated equipment rating greater than the available fault current. Series rated panelboards are not acceptable. Reference drawings for available fault current. If drawings do not have available fault current shown, then coordinate

with serving electrical utility. Final rating based on the protective device study completed under the provisions of Division 26, Electrical Distribution System Studies.

- D. Panelboard Bus Non-Reduced: Aluminum, ratings as indicated on drawings. Bus bar with suitable electroplating (tin) for corrosion control at connection. Provide copper ground bus in each panelboard.
- E. Lugs: Mechanical type for both aluminum and copper conductors. All device terminals/lugs shall be rated for a minimum of 75 degrees C to facilitate the use of 75 degrees C conductor ampacity rating.
- F. Provide double lugs and/or feed-through lugs for feed through feeders.
- G. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for poles; UL listed. Predrill bus for bolt-on breakers.
 - 1. Type SWD for lighting circuits.
 - 2. Type HACR for air conditioning equipment circuits.
 - 3. Class A ground fault interrupter circuit breakers where scheduled.
 - 4. Class B ground fault equipment protection circuit breakers for heat trace and other circuits as required by Code. Provide shunt trip circuit breakers where scheduled; provide wiring to remote trip switch/contacts as indicated on Drawings.
 - 5. Do not use tandem circuit breakers.
- H. Accessories: Provide where indicated: shunt trip, arc-fault circuit interrupter (AFCI), Class A ground fault circuit interrupter (GFCI), auxiliary switch, and alarm switch.
- I. Cabinet Front: Provide flush or surface mounting as shown on the schedules, drawings, or otherwise noted. Cabinet front with concealed hinged front cover construction, metal directory frame with heavy clear plastic protector, flush lift latch and lock, two keys per panel all keyed alike.
- J. Provide boxes with removable blank end walls and interior mounting studs. Provide interior support bracket for ease of interior installation.
- K. Furnish surface mounted cabinet boxes without knockouts.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install panelboards in accordance with NEMA PB 1.1, NECA 1 and manufacturers installation instructions.
- B. Install panelboards level and plumb. Install recessed panelboards flush with wall finishes.
- C. Height: 6-feet 6-inches to top of panelboard; install panelboards taller than 6-feet 6-inches with bottom no more than 4-inches above floor.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Include all "spaces" and "spares." Revise directory to reflect circuiting changes and as-installed conditions. Use final Owner designated room names and numbers, and not designations shown on drawings.
- F. Provide engraved plastic nameplates per Section 26 05 53, Identification for Electrical Systems.
- G. Provide arc flash labels per Section 260573, Electrical Distribution System Studies.

- H. Provide concrete housekeeping pad for floor-mounted distribution panelboards. Extend 6-inches beyond distribution panel width and depth dimensions. Minimum 3-inches above finished floor. Install plumb and level.
- I. Provide permanent identification number in or on panelboard dead-front adjacent to each breaker pole position. Horizontal centerline of numbers to correspond with centerline of circuit breaker pole position.
- J. Ground and bond panelboard enclosure per NEC.
- K. Paint:
 - 1. Standard factory finish unless noted otherwise.
 - 2. Panelboards located in finished interior areas in view of building occupants; paint to match adjacent wall surface. Color and paint preparation as specified by Architect. Covers to be painted off wall, then installed over dried, painted wall surface.
- L. Provide handle guards on each circuit supplying obviously constant loads such as fire alarm, security, lighting controls, refrigerators and freezers, fire protection, etc.
- M. Provide interior wiring diagram, neutral wiring diagram, UL label, and short circuit rating on interior or in booklet format inserted in sleeve inside panel cover.
- N. Verify available recessing depth and coordinate wall framing with other divisions.
- O. Maintain fire rating of wall where panels are installed flush in fire rated walls.
- P. Perform inspections and tests in accordance with manufacturer's requirements.
- Q. Thoroughly clean exterior and interior of each panelboard in accordance with manufacturer's installation instructions.
- R. Vacuum construction dust, dirt, and debris out of each panelboard.
- S. Where enclosure finish is damaged, touch up finish with matching paint in accordance with manufacturer's specifications and installation instructions.

3.2 POWER DISTRIBUTION PANELBOARDS INSTALLATION

- A. Breakers being added to existing panelboards: Coordinate breaker type and short circuit rating with existing panelboard. Breakers to match existing in manufacturer's type and AIC rating. Provide new typed circuit directory.
- B. Provide handle tie to branch circuit breakers of multiwire branch circuits for simultaneous disconnection of circuits. Handle tie will be identified for use with circuit breakers provided. Reconfigure assigned circuits as necessary so that circuit breakers associate with multiwire branch circuits are physically adjacent, record changes in panelboard schedules and circuiting plans for record drawings.
- C. Shunt Trip Circuit Breakers: Provide wiring to remote trip switch/contacts as indicated on Drawings.
- D. 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.

3.3 PANELBOARDS INSTALLATION

- A. Breakers being added to existing panelboards: Coordinate breaker type and short circuit rating with existing panelboard. Breakers to match existing in manufacturer's type and AIC rating. Provide new typed circuit directory.

- B. Provide handle tie to branch circuit breakers of multiwire branch circuits for simultaneous disconnection of circuits. Handle tie will be identified for use with circuit breakers provided. Reconfigure assigned circuits as necessary so that circuit breakers associated with multiwire branch circuits are physically adjacent, record changes in panelboard schedules and circuiting plans for record drawings.
- C. Shunt Trip Circuit Breakers: Provide wiring to remote trip switch/contacts as indicated on Drawings.
- D. 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.

END OF SECTION

SECTION 262726 - WIRING DEVICES**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included: Provision of materials, installation and testing of:
1. Wall Switches
 2. Receptacles
 3. Finish Plates
 4. Wall Dimmers
 5. Surface Covers

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
1. Wall switches
 2. Receptacles
 3. Wall Plates
 4. Dimmers
 5. In-Use Cover

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Wall Switches:
1. Toggle Type Characteristics:
 - a. Cooper AH1201
 - b. Hubbell HBL1221
 - c. Leviton 1221
 - d. Legrand P&S PS20AC1
 - e. Or approved equivalent.
 2. Decorative AC Rocker Switch Characteristics:

- a. Cooper
 - b. Hubbell
 - c. Leviton
 - d. Legrand P&S
 - e. Or approved equivalent.
- B. Receptacles:
- 1. Industrial Grade:
 - a. Cooper 5362
 - b. Hubbell HBL5362
 - c. Bryant BRY5362
 - d. Leviton 5362
 - e. Legrand P&S 5362A
 - f. Or approved equivalent.
 - 2. Commercial Grade:
 - a. 20 Amp:
 - 1) Cooper 5362
 - 2) Hubbell 5362
 - 3) Bryant CBRS20
 - 4) Leviton 5362S
 - 5) Legrand P&S 5362
 - 6) Or approved equivalent.
 - 3. Ground Fault Circuit Interrupter (GFCI) Receptacle - 20 Amp:
 - a. Cooper WRSGF20W
 - b. Hubbell GFR5362SGW
 - c. Legrand P&S 2097TRWR
 - d. Or approved equivalent.
 - 4. Plug Load RF Controlled Duplex Receptacle:
 - a. Half Controlled, 20 amp:
 - 1) Legrand P&S RF26352CH
 - 2) Or approved equivalent.
 - b. Dual Controlled, 20 amp:
 - 1) Legrand P&S RF26362DH
 - 2) Or approved equivalent.
 - c. RF Signal Pack:
 - 1) Legrand P&S RFP
 - 2) Wattstopper DLM WRC-TXLM
 - 3) Or approved equivalent.
- C. Finish Plates:
- 1. Bryant
 - 2. Cooper
 - 3. Hubbell
 - 4. Leviton
 - 5. Legrand P&S
 - 6. Or approved equivalent.
- D. Wall Dimmers:
- 1. Lutron Maestro Series

2. Or approved equivalent.
 - E. Surface Covers:
 1. Aluminum with Gasket, Blanks, Single Gang:
 - a. Bell 240-ALF
 - b. Carlon
 - c. Or approved equivalent.
 2. 2-Gang:
 - a. Bell 236-ALF
 - b. Carlon
 - c. Or approved equivalent.
 3. While-in-Use Weatherproof Cover:
 - a. Die Cast Cover:
 - 1) Intermatic
 - 2) Hubbell
 - 3) Cooper
 - 4) Or approved equivalent.
 - F. Provide lighting switches and receptacles of common manufacturer and appearance.
- 2.2 WALL SWITCHES
- A. Characteristics: Toggle type, quiet acting, 20 amp, 120/277 volt, UL listed for motor loads up to 80 percent of rated amperage, extra heavy duty.
 - B. Finish: White.
- 2.3 RECEPTACLES
- A. Duplex Receptacles Characteristics: Straight parallel blade, 125 volt, 2 pole, 3 wire grounding.
 1. Commercial Grade: Riveted. Back and side wired. Brass ground contact on steel strap. Nylon face and nylon base. 20 amp.
 - B. Ground Fault Circuit Interrupter (GFCI) Receptacle: Feed through type, back-and-side wired, tamper-resistant, weather resistant self-testing, 20 amp, 125VAC.
 - C. Special Purpose Receptacles: Reference Drawings for NEMA Standard Specification.
 - D. Finish:
 1. Same exposed finish as switches.
 2. Receptacles installed in surface raceway to match raceway finish. See Section 26 05 33, Raceways.
 3. All automatically controlled, nonlocking type, 125 volt, 15 amp and 20 amp rated receptacles to be permanently marked by the manufacturer with the "universal power" symbol and the word "controlled."
- 2.4 FINISH PLATES
- A. Finish Plates: Type 302 stainless steel with smooth satin finish.
 - B. Provide telephone/signal device plates; activated outlets to have coverplates to match modular jack.

2.5 WALL DIMMERS

- A. Provide wall dimmers compatible with type of load controlled (i.e. line voltage, low voltage, 2-wire, 3-wire, 0-10v). Finish to match wall switches. Size dimmers to accept connected load. Do not cut fins. Where dimmers are ganged together, provide a single multi gang coverplate.
- B. LED indicator dots show by what percentage controlled lighting is dimmed. Programmable settings for maximum and minimum trim settings, and rate of change in lighting levels.

2.6 SURFACE COVERS

- A. Material: Galvanized steel, drawn, 1/2-inch raised industrial type with openings appropriate for devices installed on surface receptacles.
- B. Cast Box and Extension Adaptors: Aluminum with gasket, blanks single gang or 2-gang.
- C. While-in-Use Weatherproof Cover: NEMA 3R when closed over energized plug. Vertical mount for duplex receptacle. Provide continuous use cover with cover capable of closing over energized cord cap with bottom aperture for cord exit.
 - 1. Die cast cover with closed cell neoprene foam gasket: Capable of being locked closed to prevent tampering or unauthorized use.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. See Architectural elevations for location and mounting height of wiring devices. Review Architectural elevations prior to rough-in and contact Architect immediately if conflicts are found between Architectural and Electrical Drawings. Do not rough-in devices until conflicts are resolved.
- B. Install wiring devices and finish plates plumb with building lines, equipment cabinets and adjacent devices. Devices not plumb will be fixed at no additional cost to Owner.
- C. Orientation:
 - 1. Install wiring devices with long dimension oriented vertically at centerline height shown on drawings or as specified.
 - 2. Vertical Alignment: When more than one device is shown on drawings in close proximity to each other, but at different elevations, align devices on a common vertical center line for best appearance. Verify with Architect.
 - 3. Horizontal Alignment: When more than one device is shown on drawings in close proximity to each other with same elevation, align devices on a common horizontal center line for best appearance. Verify with Architect.
- D. Provide labeling per Section 26 05 53, Identification for Electrical Systems.
- E. Test wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements. Test receptacles for line to neutral, line to ground and neutral to ground faults. Correct any defective wiring.

3.2 WALL SWITCHES INSTALLATION

- A. At time of substantial completion, replace those items which have been damaged.

3.3 RECEPTACLES INSTALLATION

- A. Upon installation, adhere to proper and cautious use of convenience receptacles. At time of substantial completion, replace those items which have been damaged, including those burned and scored by faulty receptacles or cord caps.
- B. In the following outlet locations, regardless of whether shown as GFCI on Drawings, either provide a GFCI duplex receptacle, or use a GFCI breaker where code would require a GFCI outlet to have a remote test switch:
 - 1. Bathrooms.
 - 2. Where receptacles are installed within 6-feet, 0-inches from edge of sinks.
 - 3. Kitchens above counters.
 - 4. On rooftops.
 - 5. Outdoors.
 - 6. Where serving vending machines.
 - 7. Where serving electric drinking fountains.
- C. GFCI Receptacles: One GFCI receptacle may not be used to provide GFCI protection to downstream duplex receptacles on the same branch circuit.

3.4 FINISH PLATES INSTALLATION

- A. Do not install items until finish painting is complete. Replace scratched and paint splattered finish plates and wiring devices.

3.5 WALL DIMMERS INSTALLATION

- A. Install per manufacturer's recommendations and wiring diagrams.

3.6 SURFACE COVERS INSTALLATION

- A. Do not install items until finish painting is complete. Replace scratched and paint splattered finish plates and wiring devices.

END OF SECTION

SECTION 262800 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Fuses
 - 2. Molded Case Circuit Breakers
 - 3. Fuse Cabinets

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Product data and instantaneous let-through current curves and average melting time current curves for fuses supplied to project.
 - 2. Product data and time/current trip curves for circuit breakers supplied to project.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements apply to this Section.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fuses:
 - 1. Bussmann
 - 2. Ferraz-Shawmut
 - 3. Littelfuse
 - 4. McGraw-Edison
 - 5. Or approved equivalent.
- B. Molded Case Circuit Breakers:
 - 1. Eaton Electrical
 - 2. ABB/General Electric
 - 3. Siemens
 - 4. Schneider Electric/Square D
 - 5. Or approved equivalent.

- C. Fuse Cabinet:
 - 1. Bussmann
 - 2. Circle AW
 - 3. Ferraz-Shawmut
 - 4. Littelfuse
 - 5. Siemens
 - 6. Schneider Electric/Square D
 - 7. Or approved equivalent.

2.2 FUSES

- A. Characteristics:
 - 1. Dual element, time delay, current limiting, nonrenewable type, rejection feature.
 - 2. Combination Loads: UL Class RK1, RK5, or J, 1/10 to 600 amp. UL Class L, above 600 amps.
 - 3. Motor Loads: UL Class RK5, 1/10 to 600 amp.
 - 4. Fuse pullers for complete range of fuses.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. 1-, 2- or 3-pole bolt-on, single handle common trip, 600VAC or 250VAC as indicated on Drawings.
- B. Overcenter toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
- C. Calibrate for operation in 40 degrees C ambient temperature.
- D. 15 to 150 Amp Breakers: Permanent trip unit containing individual thermal and magnetic trip elements in each pole.
- E. 151 to 400 Amp Breakers: Adjustable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.
- F. Greater than 401 Amp: Electronic trip type with adjustments for long-time, instantaneous, and short-time functions.
- G. Circuit breakers 1200 Amp and Greater: Provide breaker with energy-reducing maintenance switching with local status indicator per NEC Article 240.87(B).
- H. Provide ground fault function for breakers greater than 800 amps where applied at 480 volts line-to-line; and where indicated on drawings.

2.4 FUSE CABINET

- A. Enclosure:
 - 1. Metallic cabinet surface mounted, with internal shelves, trim cover with hinged and latched door.
 - 2. Size cabinet such that spare fuses required by these Documents do not exceed 50 percent of cabinet volume.
- B. Label: Provide engraved label to identify as spare fuse cabinet.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination:

1. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
2. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to overcurrent protective devices as necessary to coordinate with the nameplate rating.

B. Install all items in accordance with manufacturers written instructions.

3.2 FUSES

- A. Fuses: For each class and ampere rating of fuse installed, provide the following quantities of spares for quantity of fuses installed:
1. 0 to 24: Provide 6 spare.
 2. 25 to 48: Provide 9 spare.
 3. 49 and Above: Provide 12 spare.

3.3 MOLDED CASE CIRCUIT BREAKERS

- A. Provide testing of ground fault interrupting breakers.
- B. Provide circuit breakers, as specified and on Drawings, for installation in panelboards, individual enclosures or combination motor starters.
- C. Provide ground fault interrupter circuit breakers for equipment in damp or wet locations.
- D. Provide device on handle to lock breaker in "ON" position for breakers feeding time switches, night lights and similar circuits required to be continuously energized.
- E. Shunt Trip Circuit Breakers: Provide wiring to remote trip switch/contacts as indicated on Drawings.
- F. Where drawings indicate a GFCI device in a non-readily accessible location, provide ground fault protection at the breaker level to comply with NEC requirements.
- G. Provide multi-pole branch circuit breakers for multiwire branch circuits for simultaneous disconnection of circuits.

3.4 FUSE CABINETS

- A. Install fuse cabinet on wall in the Electrical Room in coordination with electrical equipment.

END OF SECTION

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Toggle Type Disconnect Switches
 - 2. Safety Switches

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 26 05 73, Electrical Distribution System Studies.
 - 2. Section 26 24 16, Panelboards.
 - 3. Section 26 28 00, Overcurrent Protective Devices.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Toggle Type Disconnect Switches:
 - 1. Cooper
 - 2. Hubbell
 - 3. Leviton
 - 4. Legrand (Pass & Seymour)
 - 5. Slater
 - 6. Or approved equivalent.
- B. Safety Switches:
 - 1. Eaton Electrical
 - 2. ABB/General Electric
 - 3. Siemens
 - 4. Schneider Electric/Square D
 - 5. Or approved equivalent.

2.2 TOGGLE TYPE DISCONNECT SWITCHES

- A. Rating: 120 or 277 volt, 1 or 2 pole, 20 amp, 1 hp maximum.
- B. Enclosure:
 - 1. NEMA 1: Dry locations/Indoors.
 - 2. NEMA 3R: Damp or wet locations/Outdoors.
- C. Handle lockable in 'off' position.

2.3 SAFETY SWITCHES

- A. Heavy duty fusible type and non-fusible type (as indicated on drawings), dual rated, quick-make, quick-break with fuse rejection feature for use with Class R fuses only, unless other fuse type is specifically noted.
- B. Clearly marked for maximum voltage, current, and horsepower.
- C. Operable handle interlocked to prevent opening front cover with switch in 'on' position.
- D. Switches rated for maximum available fault current.
- E. Handle lockable in 'off' position.
- F. Enclosure:
 - 1. NEMA 1: Dry locations/Indoors.
 - 2. NEMA 3R: Damp or wet locations/Outdoors.
- G. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Provide fuse rejection feature for Class R or J fuses up to 600 amp. Remove if circuit breaker type is used. Provide switches of 30 to 200 amp with plug-on line side connections.
- H. Fusible Switch Assemblies, 800 Amperes and Larger: Bolted pressure contact switches. Fuse Clips: Designed to accommodate Class L fuses. Provide with shunt-trip and ground fault capabilities. Remove if circuit breaker type is used.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Obtain and review the submitted product data for equipment furnished by the Owner, and furnished under other Divisions of this contract, particularly under Divisions 22 and 23.
- B. Confirm the equipment nameplate maximum overcurrent protection (MOCP) and make accommodations and adjustments to switches, fuses and circuit breakers as necessary to coordinate with the nameplate rating
- C. Install in accordance with manufacturer's instructions.
- D. Provide engraved nameplates per Section 26 05 53, Identification for Electrical Systems.
- E. Provide arc flash labels per Section 26 05 73, Electrical Distribution System Studies.
- F. Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed.

3.2 TOGGLE TYPE DISCONNECT SWITCHES

- A. Install fuses in fusible disconnect switches. Coordinate fuse ampere rating with installed equipment. Do not provide fuses of lower ampere rating than motor starter thermal units.

- B. Install products, systems and equipment in accordance with manufacturer's written instructions and requirements.
- C. See General Installation Requirements above.

3.3 SAFETY SWITCHES

- A. Install products, systems and equipment in accordance with manufacturer's written instructions and requirements.
- B. See General Installation Requirements above.

END OF SECTION

SECTION 265100 - LIGHTING**PART 1 - GENERAL****1.1 SUMMARY**

- A. Work Included:
 - 1. Luminaires
 - 2. LED Drivers
 - 3. Lamps
 - 4. Lighting Poles
- B. Provide wiring for complete and operating lighting system.

1.2 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NECA 500 - Commercial Lighting.
 - 2. UL 8750 – Light Emitting Diode (LED) equipment for use in lighting products.

1.4 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Submit product data for:
 - a. LED Luminaires: Electrical ratings, dimensions, mounting, material, clearances, terminations, wiring, connection diagram, LM-79 photometric data, LM-80 lumen depreciation data.
 - b. LED Drivers
 - c. Lamps
 - d. Lighting Poles
 - 2. Submittal Cutsheets: Highlight, circle or otherwise graphically indicate which option(s) are being selected for the products submitted. Cutsheets that are not edited to indicate which products and options are submitted for this project or that list only catalog numbers to identify submitted options are not acceptable.
 - 3. Specified manufacturers are approved to submit bid. However, inclusion does not relieve manufacturer from supplying product as described.
 - 4. Provide the following operating and maintenance instructions as required by Section 26 00 00, Electrical Basic Requirements:
 - a. Luminaires
 - b. LED Drivers
 - c. Lamps
 - d. Lighting Poles

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Provide luminaires acceptable to code authority for application and location installed.
 - 2. Comply with applicable ANSI standards.
 - 3. Comply with applicable NEMA standards.
 - 4. Provide luminaires and lampholders that comply with UL standards and have been listed and labeled for location and use indicated by a testing agency acceptable by the AHJ (e.g., UL, ETL, and the like).
 - 5. Comply with NEC as applicable to installation and construction of luminaires.
 - 6. Comply with fallout and retention requirements of IBC for diffusers, baffles, and louvers.
 - 7. Provide LED luminaires from the same manufacturer and manufacturing LED source batch for similar applications (e.g., all LED downlights from a single manufacturer and batch, all linear LED products from single manufacturer and batch).

1.6 WARRANTY

- A. Warranty as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. LED Luminaire Manufacturer's Warranty: Not less than 5 years for luminaire based on date of substantial completion. Includes normal cost of labor to replace luminaire. Replacement luminaire will match physical dimensions, physical appearance, chromaticity, lumen output and photometric characteristics of original installed equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Luminaires:
 - 1. Reference description and manufacturers in Luminaire Schedule on Drawings.
 - 2. Or approved equivalent.
- B. LED Drivers:
 - 1. Indoor Drivers:
 - a. eldoLED Series
 - b. Advance/Philips
 - c. Osram Sylvania
 - d. Or approved equivalent.
 - 2. Outdoor Drivers:
 - a. Advance/Philips
 - b. Osram Sylvania
 - c. LG
 - d. Or approved equivalent.
- C. Lamps:
 - 1. LED (Light Emitting Diode) Lamps:

- a. Nichia
 - b. Cree
 - c. Osram Sylvania
 - d. GE Lumination
 - e. Or approved equivalent.
2. Unless specific manufacturer not shown on this list is indicated in the Luminaire Schedule.
 3. Special types as indicated in Luminaire Schedule.
 4. Or approved equivalent.
- D. Lighting Poles:
1. Reference description and manufacturers in Luminaire Schedule on Drawings.
 2. Or approved equivalent.

2.2 LUMINAIRES

- A. Luminaires: Reference description and manufacturers in Luminaire Schedule on drawings.
- B. Where recessed luminaires are installed in cavities intended to be insulated, provide IC rated luminaires or other code approved installation.
- C. UL label luminaires installed under canopies, roof or open porches, and similar damp or wet locations, as suitable for damp or wet location.
- D. Suspended luminaires: Provide minimum 24-inch adjustability in aircraft cable length where used.
- E. Recessed Luminaires: Frame compatible with ceiling material installed at particular luminaire location. Provide proper factory trim and frame for luminaire to fit location and ceiling material. Verify with Architectural Reflected Ceiling Plan prior to submittals.
- F. Finishes:
1. Manufacturer's standard finish (unless otherwise indicated) over corrosion resistant primer.
 2. Interior Light Reflecting Finishes: White or specular finish with not less than 85 percent reflectance.
 3. Exterior Finishes: As detailed in Luminaire Schedule or on drawings. Refer cases of uncertain applicability to Architect for resolution prior to release for fabrication.
- G. Light Transmitting Components:
1. Plastic diffusers, molded or extruded of 100 percent virgin acrylic.
 2. Prismatic acrylic, extruded, flat diffusers, 0.125-inch overall thickness, unless otherwise noted.
- H. LED Luminaires:
1. UL listing of luminaire includes drivers, transformers, enclosures, rated wire, communications devices and accessories needed for a complete and functional system.
 2. LM-79: Testing and measurement of absolute photometry, chromaticity (CCT) and luminaire power. Report provided by DOE certified independent testing laboratory. CCT as specified in Luminaire Schedule.
 3. Standards: ANSI C78.377, LM-79 and LM-82 compliant for performance characteristics, photometry, colorimetry, efficacy and thermal characteristics.
 4. LM-80 + TM-21: Testing and measurement, and statistical prediction of LED lamp life. Report provided by DOE certified independent testing laboratory.

5. LEDs in one module/luminaire: Supplied from same batch/bin and fall within 3-step MacAdam Ellipse, or as described in Luminaire Schedule, whichever is the more stringent requirement.
6. Provide luminaires with integral LED thermal management system (heat sinking).
7. Luminaires to be equipped with an LED driver that accepts 120V through 277V, 50Hz to 60Hz (universal). Component-to-component wiring within the luminaire will carry no more than 80 percent of rated current and be listed by UL for use at 600VAC at 302 degrees F/150 degrees C or higher. Plug disconnects to be listed by UL for use at 600VAC, 15A or higher.
8. Provide luminaires with individual LED arrays/modules and drivers that are accessible and replaceable from exposed side of the luminaire.

2.3 LED DRIVERS

A. General:

1. Performance: Meet dimming range called out in Luminaire Schedule, free from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
3. Minimum efficiency of 85 percent, power factor greater than or equal to 0.90, compliance with reduction of hazardous substances (RoHS). Rated for operating temperature range of area in which driver is installed.
4. Limit inrush current to minimize breaker tripping.
 - a. Base specification: NEMA 410 standard for inrush current for electronic drivers.
 - b. Preferred Specification: Meet or exceed 30 milliamp-squared-seconds at 277VAC for up to 50 watts of load and 75 amps at 240 microseconds at 277VAC for 100 watts of load.
5. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
6. No visible change in light output with a variation of plus/minus 10 percent line voltage input.
7. Total Harmonic Distortion less than 10 percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD at no point in the dimming curve allows imbalance current to exceed full output THD.
8. Support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
 - a. Adjustment of forward LED voltage, supporting 3V through 55V.
 - b. Adjustment of LED current from 150mA to 1.4A at the 100 percent control input point in increments of 1mA.
 - c. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.
9. Operate for a (+/- 10 percent) supply voltage of 120V through 277VAC at 60Hz.

10. UL Recognized under the component program and modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.
11. Ability to provide no light output when the analog control signal drops below 0.3 V, or the DALI/DMX digital signal calls for light to be extinguished and consume 0.5 watts or less in this standby. Control dead band between 0.3V and 0.65V included to allow for voltage variation of incoming signal without causing noticeable variation in luminaire to luminaire output.

B. Light Quality:

1. Over the entire range of available drive currents, driver to provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0 percent relative light output, or 100 percent to 1 percent light output and step to 0 percent where indicated. Driver to respond similarly when raising from 0 percent to 100 percent.
 - a. Driver must be capable of 20 bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.
2. Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.
3. Drivers to track evenly across multiple luminaires at all light levels, and must have an input signal to output light level that allows smooth adjustment over the entire dimming range.
4. Driver and luminaire electronics to deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100 percent to 0.1 percent luminaire will have:
 - a. LED dimming driver to provide continuous step-free, flicker free dimming similar to incandescent source.
 - b. Base specification: Based on IEEE PAR1789, minimum output frequency should be greater than 1250 Hz.
 - c. Preferred specification: Flicker index to be equal to incandescent, less than 1 percent at all frequencies below 1000 Hz.

C. Control Input:

1. Provide control protocol to match lighting control system specified for use with luminaire.
2. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
 - a. Meet IEC 60929 Annex E for General White Lighting LED drivers.
 - b. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
 - c. Meet ESTA E1.3 for RGBW LED drivers.

2.4 LAMPS

- A. Provide lamps for luminaires.
- B. Provide lamp catalogued for specified luminaire type.
- C. Incandescent Lamps: Not allowed unless noted in Luminaire Schedule.
- D. LED (Light Emitting Diode):

1. LED manufacturer will include, but not be limited to, light source, luminaire, power supply and control interface with added components as needed for complete and functioning system.
 - a. Comply with ANSI chromaticity standard for classifications of color temperature. See Luminaire Schedule for specified LED lamp color and color temperature. UL or ETL listed and labeled.
 - b. Luminaire testing per IESNA LM-79 and LM-80 procedures.
 - c. Lamp life for white LEDs: 50,000 plus hours with lamp failure occurring when LED produces 70 percent of initial rated lumens.
 - d. Lamp life for color LEDs: 30,000 plus hours with lamp failure occurring when LED produces 50 percent of its initial rated lumens.
 - e. LED Drivers: Reverse polarity protection, open circuit protection, require no minimum load. Minimum 80 percent efficiency. Class A noise rating.
 - f. Dimming: LED system capable of full and continuous dimming.
 - g. Correlated Color Temperature (CCT): See Luminaire Schedule for selection of color temperature for each luminaire. Ranges given below reflect maximum allowable tolerances for color temperature range for each nominal CCT.
 - 1) Nominal CCT:
 - (a) 2700 K (2725 ± 145)
 - (b) 3000 K (3045 ± 175)
 - (c) 3500 K (3465 ± 245)
 - (d) 4000 K (3985 ± 275)
 - h. Color Rendering Index (CRI) to be greater than or equal to 80.
2. Special types as indicated in Luminaire Schedule.

2.5 LIGHTING POLES

- A. Provide exterior light poles, with concrete bases or direct buried, which are structurally supportive of pole under design loading.
- B. Provide exterior poles clean and scratch free with base bolt covers to match pole and luminaire finish.
- C. Provide poles and pole bases rated for a minimum of 100 MPH, unless otherwise noted. Wind EPA loading for quantity and type of luminaire it supports with a 1.3 gust factor.
- D. Provide poles with gasketed handholes, stainless steel tamper resistant hardware, anchor bolts and ground lugs.
- E. Description:
 1. Material: Steel, Aluminum, Treated wood, or Concrete.
 2. Shape: Tapered round, Round, or Square.
 3. Finish: Galvanized, Primed for field painting, or Anodized.
 4. Base: Embedded, Anchor, or Transformer.
 5. Accessories: Slipfitter and Mast Arms.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install per manufacturer's written installation instructions and requirements.
- B. Install luminaires securely, in neat and workmanlike manner.

- C. Install luminaires of types indicated where shown and at indicated heights in accordance with manufacturer's written instructions and with recognized industry practices to ensure that luminaires comply with requirements and serve intended purposes.
- D. Wiring:
 - 1. Recessed luminaires to be installed using flexible metallic conduit or MC Cable as allowed by Section 260519 with luminaire conductors spliced to branch circuit conductors in nearby accessible junction box over ceiling. Junction box fastened to building structural member within 6-feet of luminaire.
 - 2. Luminaires for lift out and removal from ceiling pattern without disconnecting conductors or defacing ceiling materials.
 - 3. Flexible connections where permitted to exposed luminaires; neat and straight, without excess slack, attached to support device.
 - 4. Install junction box, flexible conduit and high temperature insulated conductors for through wiring of recessed luminaires.
- E. Relamp luminaires which have failed lamps at substantial completion.
- F. Replace LED drivers deemed as excessively noisy by Architect, Engineer, or Owner.
- G. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- H. Support luminaires larger than 2- by 4-foot size independent of ceiling framing.
- I. Locate recessed ceiling luminaires as indicated on architectural reflected ceiling plan.
- J. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- K. Exposed Grid Ceilings:
 - 1. Support surface mounted luminaires in grid ceiling directly from building structure.
 - 2. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires.
 - 3. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- L. Install recessed luminaires to permit removal from below.
- M. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- N. Install clips to secure recessed grid-supported luminaires in place.
- O. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Architectural Drawings.
- P. Install accessories furnished with each luminaire.
- Q. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- R. Bond products and metal accessories to branch circuit equipment grounding conductor.
- S. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.
- T. Where manufactured wiring assemblies are used, ensure that wiring assembly manufacturer sends components to appropriate luminaire manufacturer for respective installation of proper components.

- U. Coordination:
 - 1. Coordination of Conditions: Coordinate ceiling construction, recessing depth and other construction details prior to ordering luminaires for shipment. Refer cases of uncertain applicability to Architect for resolution prior to release of luminaires for shipment. Where luminaires supplied do not match ceiling construction, replace luminaires at no cost to Owner.
 - 2. Electrical drawings are schematic, identifying quantity and type of luminaires used and their approximate location, but are not to be used for dimensional purposes. Reference architectural drawings for exact locations, including mounting heights.
 - 3. Provide lighting indicated on drawings with luminaire of the type designated and appropriate for location.
 - 4. Provide LED luminaires with driver compatible to lighting control system as shown in drawings and as specified.
 - 5. Where remote drivers are required, ensure adequate accessibility to driver. Upsize conductors between luminaire and driver to accommodate voltage drop.
- V. Field Quality Control:
 - 1. Perform field inspection in accordance with Division 01, General Requirements.
 - 2. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- W. Cleaning:
 - 1. Clean electrical parts to remove conductive and deleterious materials.
 - 2. Remove dirt and debris from enclosures.
 - 3. Clean paint splatters, dirt, dust, fingerprints, and debris from luminaires.
 - 4. Clean photometric control surfaces as recommended by manufacturer.
 - 5. Clean finishes and touch up damaged finishes per by manufacturer's instructions.
- X. Demonstrate luminaire operation for minimum of two hours.

3.2 LUMINAIRES

- A. Install per manufacturer's written installation instructions and requirements.
- B. Align, mount and level luminaires uniformly. Use ball hangers for suspended stem mounted luminaires.
- C. Avoid interference with and provide clearance from equipment. Where indicated locations for luminaires conflict with locations for equipment, change locations for luminaire by minimum distance necessary as directed by Architect.
- D. Suspended Luminaires: Mounting heights indicate clearances between bottom of luminaire and finished floors.
- E. Emergency Egress Luminaires: Provide unswitched circuit for battery charging and autotransfer circuiting for exit signs and luminaires with integral batteries. Where test switch cannot be integral to luminaire, mount remote test switch flush-to-ceiling and adjacent to egress luminaire.
- F. Interior Luminaire Supports:
 - 1. Support Luminaires: Anchor supports to structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Maintain luminaire positions after cleaning and relamping.
 - 3. Support luminaires without causing ceiling or partition to deflect.

4. Provide mounting supports for recessed and pendant mounted luminaires as required by IBC.
- G. Adjusting:
1. Aim and adjust luminaires as indicated.
 2. Focus and adjust floodlights, spotlights and other adjustable luminaires, with Architect, at such time of day or night as required.
 3. Align luminaires that are not straight and parallel/perpendicular to structure.
 4. Position exit sign directional arrows as indicated.
- 3.3 LED DRIVERS
- A. Install lamps per manufacturer's installation instructions and requirements.
 - B. Where driver is remote mounted, size wiring based on type of driver, driver distance from luminaire, and voltage/power level, and manufacturer's installation instructions.
 - C. Protect 0-10V input from line voltage mis-connection, and so it will be immune and the output unresponsive to induced AC voltage on the control leads.
- 3.4 LIGHTING POLES
- A. Install lighting poles per manufacturer's installation instructions and requirements.
 - B. Exterior Luminaire Supports:
 1. Provide concrete bases for pole-mounted lighting units and bollard lights at locations shown on site plan drawing(s). Provide concrete bases as shown on drawings or as recommended by manufacturer if not shown on drawings. Minimum base height above grade in automobile areas is 30-inches. Install luminaire poles plumb.
 2. Install pole concrete bases in undisturbed or compacted soil. Where soil is disturbed provide backfill and compaction per Division 31, Earthwork requirements.

END OF SECTION

SECTION 280001 - ELECTRONIC SAFETY BASIC REQUIREMENTS**PART 1 - GENERAL****1.1 SECTION INCLUDES**

- A. Work included in 28 00 01, Electronic Safety Basic Requirements applies to Division 28, Electronic Safety work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of electronic safety systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installing, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent," substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
 - 5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities having jurisdiction, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.2 RELATED SECTIONS

- A. Contents of Section apply to Division 28, Electronic Safety Contract Documents.
- B. Related Work:
 - 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits
- C. Contents of Division 26, Electrical apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 28, Electronic Safety Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 - 1. State of Virginia:
 - a. 2015 International Building Code (IBC) with corresponding Virginia Construction Code Supplement
 - b. 2015 International Mechanical Code (IMC) with corresponding Virginia Construction Code Supplement
 - c. 2015 International Plumbing Code (IPC) with corresponding Virginia Construction Code Supplement
 - d. 2015 International Fuel Gas Code (IFGC) with corresponding Virginia Construction Code Supplement
 - e. 2014 National Electric Code (NFPA 70-2011) with corresponding Virginia Construction Code Supplement
 - f. 2015 International Energy Conservation Code (IECC) with corresponding Virginia Construction Code Supplement
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 - 1. ABA - Architectural Barriers Act
 - 2. ADA - Americans with Disabilities Act
 - 3. ANSI - American National Standards Institute
 - 4. ASCE - American Society of Civil Engineers
 - 5. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
 - 6. ASHRAE Guideline 0, the Commissioning Process
 - 7. ASME - American Society of Mechanical Engineers
 - 8. ASTM - ASTM International
 - 9. CFR - Code of Federal Regulations
 - 10. EPA - Environmental Protection Agency
 - 11. ETL - Electrical Testing Laboratories
 - 12. FM - FM Global
 - 13. ISO - International Organization for Standardization
 - 14. NEC - National Electric Code
 - 15. NEMA - National Electrical Manufacturers Association
 - 16. NFPA - National Fire Protection Association
 - 17. OSHA - Occupational Safety and Health Administration
 - 18. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association
 - 19. UL - Underwriters Laboratories Inc.
- D. See Division 28, Electronic Safety individual Sections for additional references.

1.4 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures.

- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
- D. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
- E. Product Data: Provide manufacturer's descriptive literature for products specified in Division 28, Electronic Safety Sections.
- F. Identify/mark each submittal in detail. Note what difference, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and drawings.
 - 1. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - 2. Include technical data, installation instructions and dimensioned drawings for products, equipment and devices installed, furnished or provided. Reference individual Division 28, Electronic Safety specification Sections for specific items required in product data submittal outside of these requirements.
 - 3. See Division 28, Electronic Safety individual Sections for additional submittal requirements outside of these requirements.
- G. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
- H. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
- I. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 28, Electronic Safety Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical and Division 28, Electronic Safety submittals.

- J. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
- K. Substitutions and Variation from Basis of Design:
1. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 2. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor are required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals." For any product marked "or approved equivalent," a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
 3. Where manufacturer equipment or model numbers are indicated with no exceptions, substitutions will be rejected.
- L. Shop Drawings:
1. Provide coordinated shop drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 28, Electronic Safety specification Sections for additional requirements for shop drawings outside of these requirements.
 2. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
- M. Samples: Provide samples when requested by individual Sections.
- N. Resubmission Requirements:
1. Make any corrections or change in submittals when required by Architect/Engineer review comments. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 2. Resubmit for review until review indicates no exception taken or "make corrections noted."
 3. When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
- O. Operation and Maintenance Manuals, Owner's Instructions:
1. Reference individual Division 28, Electronic Safety Specification Sections for additional requirements for operations and maintenance manuals.
 2. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as

submittals. Include name and location of source parts and service for each piece of equipment.

- a. Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - b. Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes and quantities relevant to each piece of equipment.
 - c. Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub-assemblies.
 - d. Include Warranty per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Sections.
 - e. Include product certificates of warranties and guarantees.
 - f. Include copy of start-up and test reports specific to each piece of equipment.
 - g. Include commissioning reports.
 - h. Engineer will return incomplete documentation without review.
 - i. Engineer will provide one set of review comments in Submittal Review format. Arrange for additional reviews; Bear costs for additional reviews at Engineer's hourly rates.
3. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 28 00 01, Electronic Safety Basic Requirements Article titled "Demonstration."
 4. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

P. Record Drawings:

1. Maintain at site at least one set of drawings for recording "as-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements and location of concealed items. Include items changed by addenda, field orders, supplemental instructions, and constructed conditions.
2. Record Drawings are to include equipment locations, calculations, and schedules that accurately reflect "as constructed or installed" for project.
3. At completion of project, input changes to original project on Revit Model and make one set of black-line drawings created from Revit Model in version/release equal to contract drawings. Submit Revit disk and drawings upon substantial completion.
4. See Division 28, Electronic Safety individual Sections for additional items to include in Record Drawings.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at

variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (e.g. cable tray, panels, etc.) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.

1.6 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.7 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, and clearances of existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacture, including but not limited to panels, devices and equipment unless otherwise specified in individual Division 28, Electronic Safety Sections.

2.2 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or FM approved or have adequate approval or be acceptable by state, county, and city authorities.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of Virginia, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.1 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
- B. Install equipment having components requiring access (i.e., devices, equipment, electrical boxes, panels, etc.) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.
- D. Earthwork:
 - 1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork divisions.

Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.

- b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection.
 2. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around conduit, raceway and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Plenums: In plenums, provide plenum rated materials that meet the requirements to be installed in plenums.

3.2 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 1. Underground conduit and wire installation prior to backfilling.
 2. Prior to covering walls when electronic safety systems installation is started.
 3. Prior to ceiling cover/installation.
 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Final Punch: Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.3 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements in Division 01, General Requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
 2. Prior to changing over to new system, verify that every item is thoroughly prepared. Install new wiring to point of connection.
 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 4. Organize work to minimize duration of power interruption.

3.4 CUTTING AND PATCHING

- A. Confirm Cutting and Patching Requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
 3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
 4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, repair, refinish and leave in condition matching existing prior to commencement of work.
 5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.5 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.6 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with the individual Division 28, Electronic Safety Sections and the following:
1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust.
 2. Protect equipment and pipe to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect devices, panels and similar items until in service.
 4. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.

3.7 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.

- B. Upon completion of work and adjustment of equipment, test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Staff as specified in Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified factory certified instructor at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.8 CLEANING

- A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28 Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.9 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 28 00 01, Electronic Safety Basic Requirements and individual Division 28, Electronic Safety Sections.
- B. Install equipment in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to building structure. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- D. Provide miscellaneous supports required for installation of equipment, conduit and wiring.

3.10 PAINTING

- A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e. hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. In electrical and mechanical room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.

5. Conduit: Clean, primer coat and paint interior conduit exposed in finished areas with two coats paint suitable for metallic surfaces. Color selected by Architect.

3.11 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In the absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 1. Scope:
 - a. It is the intent of these documents to provide necessary information and adjustments to electronic safety system required to meet code, and accommodate installation of new work.
 - b. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
 - c. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access, access to different areas. Owner will cooperate to best of their ability to assist in coordinated schedule, but will remain final authority as to time of work permitted.
 2. Examination:
 - a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
 - b. Verify that abandoned wiring and equipment serve only abandoned facilities.
 - c. Demolition drawings are based on casual field observation and existing record documents.
 - 1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
 - 2) Verify location and number of electronic safety system devices, panels, etc. in field.
 - d. Report discrepancies to Architect before disturbing existing installation.
 3. Promptly notify Owner if systems are found which are not shown on Drawings.
 4. Execution:
 - a. Remove existing electronic safety equipment, devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.
 - b. Provide temporary wiring and connections to maintain electrical continuity of existing systems during construction. Remove or relocate electrical boxes, conduit, wiring and equipment as encountered in removed or remodeled areas in existing construction affected by this work.
 - c. Remove and restore wiring which serves usable existing outlets clear of construction or demolition.
 - d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, provide new conduit and wire to bypass abandoned outlets.

- e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and wire to reroute clear of construction or demolition and maintain service to existing load.
 - f. Extend circuiting and devices in existing walls to be furred out.
 - g. Remove abandoned wiring to source of supply.
 - h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
 - i. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
 - j. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
 - k. Existing electronic safety system components are indicated on demolition plans. Verify exact location and number of existing devices and components in field. Only partial existing systems shown. Locations of items shown on Drawings as existing are partially based on Record and other Drawings which may contain errors. Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish intent of Contract Documents.
 - l. Remove abandoned wiring to leave site clean.
 - m. If existing electrical equipment contains PCBs (Polychlorinated Biphenyl), replace with new non-PCB equipment. Dispose of material containing PCBs as required by federal and local regulations.
 - n. Repair adjacent construction and finishes damaged during demolition work.
 - o. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
5. Existing Fire Alarm System: Maintain existing system in service during construction. Disable system only to make switchovers and connections.
- a. Notify Owner before partially or completely disabling system.
 - b. Notify local fire service.
 - c. Make notifications at least five (5) working days in advance.
 - d. Make temporary connections to maintain service in areas adjacent to work area.

3.12 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Cleaning
 - b. Operation and Maintenance Manuals
 - c. Training of Operating Personnel
 - d. Record Drawings
 - e. Warranty and Guaranty Certificates
 - f. Start-up/test Documents and Commissioning Reports

3.13 FIELD QUALITY CONTROL

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 28, Electronic Safety Sections and the following:
 - 1. Tests:
 - a. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Closeout Documents.
 - b. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.14 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement in letter that electronic safety systems were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in operating and maintenance manuals.

END OF SECTION

SECTION 283100 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Fire Alarm Control Units
 - 2. Notification Appliance Circuit Panels
 - 3. Fire Alarm Transmitters
 - 4. Fire Alarm Annunciators
 - 5. Fire Alarm Graphic Annunciator
 - 6. Fire Alarm Emergency Voice/Alarm Communications System Control Units
 - 7. Manual Pull Stations
 - 8. Relay Modules
 - 9. Control Modules
 - 10. Input Modules
 - 11. Fault Isolation Modules
 - 12. Combination Speaker/Strobes
 - 13. Strobes
 - 14. Miscellaneous Accessories
- B. Scope:
 - 1. Provide a new fire alarm system.
 - 2. Provide a new fire alarm transmitter communication system.
- C. In addition, provide design for the following as required in these Contract Documents:
 - 1. Fire Alarm System
 - 2. Fire Alarm Transmitter Communication System
- D. System Design:
 - 1. Design Criteria:
 - a. These are Contractor designed systems. Contact AHJ prior to bid to verify systems' requirements. Design systems in compliance with code as interpreted by the AHJ.
 - 2. Design of Fire Alarm System:
 - a. Provide design of the fire alarm system as required by code.
 - b. Fire Alarm Sequence of Operation: Activation of manual fire alarm box, automatic fire detector, or fire extinguishing system causes system to enter "alarm" mode including the following operations:
 - 1) Local English language annunciation of device location, address and condition and audible and visual alarm signal at control panel and remote annunciators.
 - 2) Manual "acknowledge" function at control panel and remote annunciators to silence audible alarm signal, visual signal remains displayed until initiating alarm is cleared.
 - 3) Transmit "alarm" signal to off-premises equipment, i.e., to local fire department or Owner's selected vendor. Provide necessary connections to transmitter.
 - 4) Activate fire alarm notification appliances.
 - 5) Activate Emergency Control Functions as required by code.
 - (a) Transmit signal to fire/smoke dampers.
 - (b) Transmit signal to initiate shutdown of air handling equipment.

- (c) Transmit signal to release fire doors.
 - (d) Transmit signals to elevator control equipment to initiate elevator recall and shunt trip.
 - c. Supervisory Sequence of Operation: Fire sprinkler tamper or supervisory pressure switch activation, or duct-mounted smoke detector activation causes system to enter "supervisory" mode including the following operations:
 - 1) Local English language annunciation of device location, address and condition and audible and visual supervisory signal at control panel and remote annunciators.
 - 2) Manual "acknowledge" function at control panel and remote annunciators to silence audible supervisory signal, visual signal remains displayed until initiating supervisory is cleared.
 - 3) Transmit "supervisory" signal to off-premises equipment.
 - 4) Transmit signal to fire/smoke dampers (duct detector only).
 - 5) Transmit signal to initiate shutdown of air handling equipment (duct detector only).
 - d. Trouble Sequence of Operation: System trouble, including single ground or open of supervised circuit, or power or system failure, causes system to enter "trouble" mode including the following operations:
 - 1) Local English language annunciation of device location, address and condition and audible and visual trouble signal at control panel and remote annunciators.
 - 2) Manual "acknowledge" function at control panel and remote annunciators to silence audible trouble signal, visual signal remains displayed until initiating trouble is cleared.
 - 3) Transmit "trouble" signal to off-premises equipment.
- 3. Design of Fire Alarm Transmitter Communication System:
 - a. Provide design of the fire alarm transmitter communication system as required by code.

1.2 RELATED SECTIONS

- A. Contents of Division 28, Electronic Safety and Security and Division 01, General Requirements apply to this Section.
- B. Division 26, Electrical requirements apply to this section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Division 28, Electronic Safety and Security and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NFPA 72, National Fire Alarm and Signaling Code, adopted edition.
 - 2. NFPA 70, National Electrical Code, adopted edition.

1.4 SUBMITTALS

- A. Submittals as required by Division 28, Electronic Safety and Security and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Shop drawings to include the following:

- a. Provide system designer NICET certification number or Engineer's signature and seal on shop drawings.
 - b. Identification of system designer and evidence of qualification or certification of designer as required by AHJ.
 - c. Floor plans indicating walls, doors, partitions, room descriptions, device/component locations.
 - d. Ceiling height and ceiling construction details.
 - e. A symbol legend with device catalog number, description, back box size and mounting requirements.
 - f. Detailed riser diagram.
 - g. Device address adjacent to each device symbol. Notification appliance circuit and number adjacent to each notification appliance symbol.
 - h. Point to point wiring indicating the quantity and gauge of the conductors and size of conduit/raceway used.
 - i. Wiring connection diagrams for control equipment, annunciators, power supplies, chargers, initiating devices, notification appliances, components being connected to the system and interfaces to associated equipment.
 - j. Battery calculations for each battery backed fire alarm control unit.
 - k. Voltage drop calculations for each notification appliance circuit, indicating individual appliance current draw, conductor run length and size.
 - l. Complete sequence of operation.
2. Prior to final acceptance, submit a letter confirming that inspections have been completed and system is installed and functioning in accordance with Specifications. Include manufacturer representative's certification of installation and letter of warranty.
 3. Operation and Maintenance Manuals. Provide manuals containing the following:
 - a. Catalog Cut Sheets
 - b. System Components, Initiating Devices and Notification Appliances' Installation Sheets
 - c. Manufacturer's Installation, Operation and Maintenance Manual
 - d. Program Data File Printout
 - e. Program Data File on Electronic Storage Media
 - f. Record Drawings
 - g. Record Drawings on Electronic Storage Media
 - h. One year warranty agreement including parts and labor. Warranty period begins upon date of completion.
 - i. Record of Completion
 - j. Test Reports
 - k. Instruction Chart

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Division 28, Electronic Safety and Security and Division 01, General Requirements.
- B. In addition, meet the following:
 1. City of Arlington, Virginia requirements, ordinances and amendments.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Division 28, Electronic Safety and Security and Division 01, General Requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fire Alarm Control Units:
 - 1. EST
 - 2. Farenhyt
 - 3. Gamewell-FCI
 - 4. Johnson Controls
 - 5. Notifier
 - 6. Potter
 - 7. Siemens
 - 8. Silent Knight
 - 9. Simplex
 - 10. Or approved equivalent.
- B. Notification Appliance Circuit Panels:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. Alarmsaf
 - 3. Altronix
 - 4. Federal Signal
 - 5. Wheelock
 - 6. Or approved equivalent.
- C. Fire Alarm Transmitters:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. Or approved equivalent.
- D. Fire Alarm Annunciators:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. Or approved equivalent.
- E. Fire Alarm Graphic Annunciators:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. Kirkland
 - 3. Space Age Electronics
 - 4. Or approved equivalent.
- F. Fire Alarm Emergency Voice/Alarm Communications System Control Units:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. Or approved equivalent.
- G. Manual Pull Stations:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. No substitutions permitted.
- H. Relay Modules:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. No substitutions permitted.

- I. Control Modules:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. No substitutions permitted.
- J. Input Modules:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. No substitutions permitted.
- K. Fault Isolation Modules:
 - 1. Same manufacturer as fire alarm control equipment.
 - 2. No substitutions permitted.
- L. Combination Speaker/Strobes:
 - 1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
 - 2. Same manufacturer as fire alarm control equipment.
 - 3. Federal Signal
 - 4. Gentex
 - 5. System Sensor
 - 6. Wheelock
 - 7. Or approved equivalent.
- M. Strobes:
 - 1. Must be compatible with fire alarm control equipment and notification appliance circuit panels.
 - 2. Same manufacturer as fire alarm control equipment.
 - 3. Federal Signal
 - 4. Gentex
 - 5. System Sensor
 - 6. Wheelock
 - 7. Or approved equivalent.
- N. Miscellaneous Accessories:
 - 1. Weatherproof/Surface Backboxes:
 - a. Same manufacturer as fire alarm detection devices or notification appliances.
 - b. Or approved equivalent.
 - 2. Protective Guard:
 - a. Wire Guard:
 - 1) Same manufacturer as fire alarm control equipment.
 - 2) American Wire Guards
 - 3) Chase Security Systems
 - 4) Safety Technology International
 - 5) Shaw-Perkins
 - 6) Or approved equivalent.
 - b. Protective Cover:
 - 1) Safety Technology International
 - 2) Or approved equivalent.
 - 3. Circuit Conductors:
 - a. Allied Wire and Cable
 - b. Belden

- c. CCI
- d. West Penn Wire
- e. Or approved equivalent.
- 4. Surge Protection:
 - a. Ditek
 - b. Transtector
 - c. Or approved equivalent.
- 5. Batteries:
 - a. Same manufacturer as fire alarm control equipment.
 - b. Power-Sonic
 - c. Werker
 - d. Or approved equivalent.
- 6. Locks and Keys:
 - a. Same manufacturer as fire alarm control equipment.
 - b. Or approved equivalent.
- 7. Document Storage Cabinet:
 - a. Same manufacturer as fire alarm control equipment.
 - b. Meir Products
 - c. Space Age
 - d. Or approved equivalent.
- 8. Instruction Charts:
 - a. Confirm make and model with architect prior to ordering.
- 9. Framed Floor Map:
 - a. Confirm make and model with architect prior to ordering.
- O. Substitutions:
 - 1. For other acceptable manufacturers of specified control units, submit product data showing equivalent features and compliance with Contract Documents.
 - 2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with contract documents.
- P. Equipment to be supplied by a certified manufacturer representative.

2.2 FIRE ALARM CONTROL UNITS

- A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.
- B. Multiprocessor Based: Configurable as an addressable, point identified system.
- C. Central Processing Unit (CPU):
 - 1. CPU continuously monitors the communications and data processing cycles of microprocessor. CPU failure generates an audible and visual trouble signal on control panel and remote annunciators.
 - 2. House the CPU in fire alarm cabinet with sufficient space to allow maximum system expansion and to enclose alphanumeric display.
 - 3. Retain basic life safety software in field programmable non-volatile memory. Provide CPU with capacity of minimum of 50 addressable points.
 - 4. Equip CPU with software to provide a control-by-event feature, whereby receipt of an alarm point is programmed to operate control points within system. Provide

control-by-event actions for life safety functions in programmable non-volatile memory. CPU software programming for control of systems defined in this Section is installed as part of this Section.

- D. System Capabilities:
 - 1. System capable of addressing and operating smoke detectors, manual pull stations, open contact devices and addressable auxiliary control relays on the same communication loop.
 - 2. System capable of displaying value of each smoke detector, address and condition of fire alarm monitoring points.
- E. Program Software:
 - 1. Field configuration program provides programmable operating instructions for system. Store resident program in non-volatile memory.
 - 2. Programmed control point activation includes selective control of HVAC, fire door release, elevator recall, elevator shunt trip, and other fire safety and auxiliary functions.
 - 3. Devices meet criterion specified under materials.
 - 4. Verification and display of sensitivity of each addressable smoke detector can be read using the operating software. Replace devices with readings outside of allowed value at time of system check out.
- F. Control Panel Display Modules:
 - 1. Provide keyboard display module 80-character backlit LCD. Each alarm/trouble condition appears in English language with description and location of alarm/supervisory/trouble.
 - 2. Alarm/supervisory/trouble may be acknowledged, silenced and system reset from control panel or remote annunciator(s).
- G. Power Supply: Provide power supply(s), adequate to serve control panel modules, remote annunciators, addressable devices, notification appliances and other connected devices.
- H. Power Requirements:
 - 1. Loss of 120VAC power automatically causes system to transfer to battery power. Indicate battery power operation by yellow lamp and audible annunciation at control panel and remote annunciator panels. Upon return of 120VAC power, unit recharges batteries to full capacity and maintains battery on float charge. Provide trickle charge adequate capacity to maintain battery fully charged with automatic rate charge.
 - 2. Provide batteries in locking cabinet manufactured for purpose.
- I. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts for each function in this portion of the Specifications and for equipment interconnections required under electrical and mechanical specifications.
- J. Auxiliary Switches: Provide auxiliary equipment control switches with labeled status indicating lights for each switch.
- K. System Reset:
 - 1. Key-accessible control function returns system to normal, non-alarm state, if initiating circuits have cleared.
 - 2. Provide reset on both main fire alarm control panel and remote annunciators.
- L. Lamp Test: Manual "lamp test" function causes the annunciation lamps to illuminate at fire alarm control and remote annunciator panels. Provide "lamp test" function at each annunciator panel.

M. Addressing: Provide each initiating device with its own discrete address.

2.3 NOTIFICATION APPLIANCE CIRCUIT PANELS

- A. Provide power supply(s), adequate to serve modules, remote annunciators, addressable devices, notification appliances and other connected devices or appliances.
- B. Loss of normal and emergency power automatically causes system to transfer to battery power. Indicate battery power operation by yellow lamp and audible annunciation at control panel and remote annunciator panels. Upon return of 120VAC power, unit recharges batteries to full capacity and maintains battery on float charge. Provide trickle charge adequate capacity to maintain battery fully charged with automatic rate charge.
- C. Provide batteries in locking cabinet manufactured for purpose.

2.4 FIRE ALARM TRANSMITTERS

- A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.
- B. Electrically supervised, capable of transmitting alarm, supervisory and trouble signals over RF, GSM, Cellular, or Ethernet lines to off-premises receiver. Signal transmitter interfaces fully with receiver station of local fire department or Owner's selected vendor.
- C. Verify requirements and provide call sequence and message as directed by Owner and the AHJ.

2.5 FIRE ALARM ANNUNCIATORS

- A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.
- B. Alphanumeric Remote Annunciator with Controls: Back lit LCD alphanumeric annunciator 80 characters long. Provide under locking cover test switch, alarm and trouble buzzer, buzzer silence switch and buzzer silence message and reset switch, flush mount with finished cover, vandal-resistant UV stabilized Lexan (or approved equivalent) overlay and required modules, control panel, etc., to drive annunciator. Self-contained, suitable for wet location where located exterior. Verify location with AHJ before installation.

2.6 FIRE ALARM GRAPHIC ANNUNCIATOR

- A. Cold rolled, 16 gauge steel with black powder finish.
- B. Piano hinge, lock.
- C. Terminal blocks, drivers, wiring and other components required for system operation.
- D. Acrylic UV laminated display.
- E. LEDs installed behind clear front, tamperproof viewing window.

2.7 FIRE ALARM EMERGENCY VOICE/ALARM COMMUNICATIONS SYSTEM CONTROL UNITS

- A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.
- B. Multi-channeled system. Each channel operates independently. Faults on one channel will not impede operation of other.
- C. UL 864 listed.

- D. LED indicators for power trouble, ground trouble and signal trouble in each NAC. Also, LED indicators for manual evacuation status, clear status and "ready to talk" status for manual microphone paging.
- E. Selectable audio tones (at least four different tone patterns) and voice message generation via digital recorded messages (either Owner supplied, from professionally recorded tapes or manufacturer provided library).
- F. Operator controls at panel include manual evacuation (alarm signal from momentary switch activation), manual clear from momentary switch activation, local microphone manual paging, remote microphone manual paging option.
- G. Integrated within fire alarm control panel.
- H. Include audio amplifiers.
- I. Built-in spoken diagnostic system testing program, permitting testing of individual speakers by one unassisted person.

2.8 MANUAL PULL STATIONS

- A. Provide flush mounted units where installed in finished areas; in unfinished areas, surface mounted units are acceptable, unless otherwise noted.
- B. Semi-flush, red finish, nongrasping operation; maximum pull strength as allowed per ADA criteria.
- C. Stations do not allow closure without keyed reset.

2.9 RELAY MODULES

- A. Signaling line circuit interface module that connects to other building systems for control of fire/life safety functions, e.g., air-handler shutdown, fire/smoke damper closure, elevator recall.
- B. Module powered from control panel.

2.10 CONTROL MODULES

- A. Signaling line circuit interface module that provides notification appliance circuits or system control outputs.
- B. Module powered from control panel.

2.11 INPUT MODULES

- A. Signaling line circuit interface module that provides initiating device circuits for connection to contact closure initiating devices.
- B. Module powered from control panel.

2.12 FAULT ISOLATION MODULES

- A. Signaling line circuit interface modules that provide isolation of wire-to-wire shorts on a signaling line circuit with automatic reconnection upon correction of short circuit.
- B. Provide module with status indicator LED.

2.13 COMBINATION SPEAKER/STROBES

- A. Multi-candela, flush wall and ceiling mount, white finish. Insect-proof, 4-inch multitap to 1/4, 1/2, 1 and 2 watts with backbox and trim grill. Provide speaker capable of transmitting tone or voice.
- B. Provide with integral ANSI 117.1 and UL 1971 approved strobe light. Provide strobes that meet the latest requirements of NFPA 72, ANSI 117.1 and UL 1971. Candela rating as required by NFPA 72.

2.14 STROBES

- A. Multi-candela, flush wall and ceiling mount, white finish, insect-proof.
- B. Provide strobes that meet the latest requirements of NFPA 72, ANSI 117.1 and UL 1971. Candela rating as required by NFPA 72.

2.15 MISCELLANEOUS ACCESSORIES

- A. Protective Guard:
 - 1. Wire Guard: Steel wire guard.
 - 2. Protective Cover: Polycarbonate construction.
- B. Circuit Conductors: Copper or optical fiber; color code and label. Type FPL, FPLR and FPLP as required by NEC. Minimum signaling line circuit and initiating device circuit wire size: AWG18. Minimum notification appliance circuit wire size: AWG14, or as approved by Engineer. Fiber optic cable as required by manufacturer.
- C. Surge Protection: In accordance with IEEE C62.41 B3 combination waveform and NFPA 70; except for optical fiber conductors.
- D. Batteries: Sealed lead acid type. Provide additional cabinet, if required due to space limitations in control panels.
- E. Locks and Keys:
 - 1. Deliver keys to Owner.
 - 2. Provide same standard lock and key for each key operated switch and lockable panel and cabinet; provide five keys of each type.
- F. Document Storage Cabinet:
 - 1. Suitable for as-built drawings, operation and maintenance manual, system data file disk and tools.
 - 2. Constructed from steel with baked enamel finish; size adequate for full size drawings, operation and maintenance manual, spare parts and tools.
- G. Instruction Charts:
 - 1. Printed instruction chart for operators, showing steps to be taken when signal is received (normal, alarm, supervisory and trouble); easily readable from normal operator's station.
 - 2. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
- H. Framed Floor Map:
 - 1. Provide framed floor plan of facility.
 - 2. Frame: Stainless steel or aluminum with polycarbonate or glass cover.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Obtain Architect's approval of locations of devices, appliances and annunciators before installation.
- B. Circuits:
 - 1. Signaling Line Circuits (SLC): Class B
 - 2. Notification Appliance Circuits (NAC): Class B.
- C. Spare Capacity:
 - 1. Notification Appliance Circuits: Minimum 25 percent spare current capacity. Utilize UL maximum current draw values for notification appliances. Maximum 10 percent voltage drop.
 - 2. Signaling Line Circuit: Minimum 25 percent spare capacity.
- D. Power Sources:
 - 1. Primary: Dedicated branch circuits of facility power distribution system.
 - 2. Secondary: Storage batteries.
 - 3. Capacity: Sufficient to operate fire alarm system under normal supervisory condition for 24 hours and operate alarm signals for five minutes at end of standby period.
- E. Obtain approval of system design from AHJ prior to installation. Do not begin installation without approval from AHJ and submittal review comments from Engineer.
- F. Install in accordance with applicable codes, NFPA 72, NFPA 70 and the Contract Documents.
- G. In accordance with manufacturer's instructions, provide wiring, conduit and outlet boxes required for the erection of a complete system as described in these specifications, as shown on Drawings and as required by AHJ.
- H. Conceal wiring, conduit, boxes and supports where installed in finished areas.
- I. Provide raceway system for cabling concealed in walls and hard ceilings and in locations where cabling is exposed. Where exposed, provide surface raceway in finished areas and surface mounted EMT in non-finished areas.
- J. Provide cabling and conduits system suitable for wet locations for below grade systems.
- K. At junction boxes and termination points, provide identification tags on wires and cables.
- L. Route wiring to avoid blocking access to equipment requiring service, access, or adjustment.
- M. Fire Safety Systems Interfaces:
 - 1. Provide conduit, wiring, boxes and terminations from fire alarm system to monitored components.
 - a. Alarm Inputs: Provide connection in accordance with NFPA 72 for the following systems and components:
 - 1) Fire sprinkler water flow switches.
 - 2) Fire sprinkler dry-pipe alarm pressure switches.
 - 3) Kitchen hood fire suppression activation.
 - 4) Other alarm inputs.
 - b. Supervisory Inputs: Provide connection in accordance with NFPA 72 for the following systems and components:
 - 1) Fire sprinkler water control valve tamper switches.
 - 2) Fire sprinkler dry-pipe system low air pressure switches.

- 3) Elevator shunt trip power monitoring circuit.
 - 4) Other supervisory inputs.
 - c. Trouble Inputs: Provide connection in accordance with NFPA 72 for the following systems and components:
 - 1) Other trouble inputs.
2. Fire Safety Functions: Provide power and control conduit, wiring, boxes and terminations to power devices and interface to fire alarm system.
- a. Doors:
 - 1) Provide smoke detectors and addressable control relays to release magnetic hold open devices and roll-down fire doors and door locks. Verify requirements and quantities prior to bidding.
 - 2) Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door.
 - 3) Electronic Locks or Electromagnetic Door Locks on Egress Doors: Unlock smoke zone egress doors upon activation of any alarm initiating device or suppression system in smoke zone.
 - 4) Overhead Coiling Fire Doors: Release upon activation of smoke detectors on either side of door.
 - b. Elevators:
 - 1) Provide elevator recall smoke detectors, addressable control relays and connection to elevator equipment per NFPA 72 and as required by the AHJ.
 - 2) Provide elevator shunt trip heat detectors, addressable control relays for shunt trip operation, addressable input module for monitoring shunt trip power and connection to elevator equipment per NFPA 72 and as required by the AHJ.
 - 3) Elevator Lobby and Machine Room Smoke Detectors: Elevator recall for fire fighters' service.
 - 4) Elevator Machine Room Heat Detector: Shut down elevator power prior to Elevator Machine Room sprinkler activation.
 - c. HVAC Systems:
 - 1) Fire/Smoke Dampers and Smoke Dampers:
 - (a) Provide required smoke detectors, relays, wiring and the like.
 - (b) Connect control and power wiring to dampers per manufacturer's instructions.
 - (c) Verify quantities, location and requirements of dampers with Division 23, HVAC Drawings and Specifications and mechanical system installer.
 - 2) Air Moving Systems:
 - (a) Provide duct-mounted smoke detectors on air systems with air flow rates exceeding 2000 CFM. Coordinate with Division 23, HVAC.
 - (b) Install duct-mounted smoke detector(s) on return side of air system.
 - (c) Provide control wiring from addressable relay contacts to air handling equipment controller. Connect to controller so that when duct-mounted smoke detector is activated, the air handling equipment is shut down.
 - (d) Provide duct-mounted smoke detectors rated for air velocity, temperature and humidity of duct. Verify quantities, locations and requirements with Division 23, HVAC Drawings and mechanical system installer.

- (e) Where duct-mounted smoke detectors are mounted in inaccessible building void spaces provide access hatch. Provide access hatch with fire rating equivalent to rating of wall, ceiling, or shaft being penetrated.
- N. Inspection and Testing for Completion:
- 1. System testing and commissioning to be performed by a certified manufacturer representative.
 - 2. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
 - 3. Document audibility measurements and verify intelligibility for each space on record drawings.
 - 4. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction and adjustments.
 - 5. Provide tools, software and supplies required to accomplish inspection and testing.
 - 6. Prepare for testing by ensuring that work is complete and correct; perform preliminary tests as required to test system.
 - 7. Correct defective work, adjust for proper operation and retest until entire system complies with Contract Documents.
 - 8. Notify Owner seven days prior to beginning completion inspections and tests.
 - 9. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
 - 10. Diagnostic Period: After successful completion of inspections and tests, operate system in normal mode for at least 14 days without any system or equipment malfunctions.
 - a. Record all system operations and malfunctions.
 - b. If a malfunction occurs, start diagnostic period over after correction of malfunction.
 - c. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
 - d. At end of successful diagnostic period, complete and submit NFPA 72 "Inspection and Testing Form."
- O. Owner Personnel Instruction:
- 1. Provide the following instruction to designated Owner personnel:
 - a. Hands-On Instruction: On-site, using operational system.
 - b. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
 - 2. Basic Operation: One-hour sessions for attendant personnel, security officers and engineering staff; combination of classroom and hands-on:
 - a. Initial Training: One session pre-closeout.
 - b. Refresher Training: One session post-occupancy.
 - 3. Detailed Operation: Two-hour sessions for engineering and maintenance staff; combination of classroom and hands-on:
 - a. Initial Training: One session pre-closeout.
 - b. Refresher Training: One session post-occupancy.
 - 4. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data and record drawings available during instruction.
 - 5. Provide means of evaluation of trainees suitable to type of training given; report results to Owner.
- P. Closeout:
- 1. Closeout Demonstration:

- a. Demonstrate proper operation of functions to Owner.
 - b. Be prepared to conduct any of the required tests.
 - c. Have at least one copy of operation and maintenance data, copy of project record drawings, input/output matrix and operator instruction chart(s) available during demonstration.
 - d. Have authorized technical representative of control unit manufacturer present during demonstration.
 - e. Demonstration may be combined with inspection and testing required by AHJ. Notify AHJ in time to schedule demonstration.
 - f. Repeat demonstration until successful.
2. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
- a. Specified diagnostic period without malfunction has been completed.
 - b. Approved operating and maintenance data has been delivered.
 - c. Spare parts, extra materials and tools have been delivered.
 - d. All aspects of operation have been demonstrated to Architect.
 - e. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 - f. Occupancy permit has been granted.
 - g. Specified pre-closeout instruction is complete.
3. Perform post-occupancy instruction within three months after date of occupancy.

3.2 FIRE ALARM CONTROL UNITS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide control units with 120VAC dedicated circuit per NFPA requirements.
- D. Do not install cabinets or equipment below the battery cabinet. Do not locate battery and charging system cabinets in ceiling space.
- E. Provide instruction charts at each control unit where system operations are performed. Obtain approval from the Architect prior to mounting.
- F. Perform system programming at the fire alarm control panel. Program the system without shutting the system down. Programming is done off line. Update and maintain hard copy and CD-ROM copy of program at the site.
- G. Room Name Labeling: Control unit schedules, programming and labeling for electrical equipment, to use the room names and room numbers that the Architect adopts at the date of substantial completion of construction. This work is to be done at no added cost to the Owner.
- H. Programmable Function Keys: Provide control panel accessible function keys for the notification bypass, fire drill, fire door bypass, elevator control bypass, and supervising station bypass.

3.3 NOTIFICATION APPLIANCE CIRCUIT PANELS

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide notification appliance circuit panel power supplies with 120VAC dedicated circuit per NFPA requirements.

- D. Do not install cabinets or equipment below the battery cabinet. Do not locate battery and charging system cabinets in ceiling space.
- 3.4 FIRE ALARM TRANSMITTERS
- A. Reference 3.01, General Installation Requirements.
 - B. Install per manufacturer's instructions and recommendations.
 - C. Provide conduit and wiring for connections to the transmitter as required for fire alarm system off site supervision.
- 3.5 FIRE ALARM ANNUNCIATORS
- A. Reference 3.01, General Installation Requirements.
 - B. Install per manufacturer's instructions and recommendations.
- 3.6 FIRE ALARM GRAPHIC ANNUNCIATORS
- A. Reference 3.01, General Installation Requirements.
 - B. Install per manufacturer's instructions and recommendations.
- 3.7 FIRE ALARM EMERGENCY VOICE/ALARM COMMUNICATIONS SYSTEM CONTROL UNITS
- A. Install instruction cards in or adjacent to control units.
 - B. Reference 3.01, General Installation Requirements.
 - C. Install per manufacturer's instructions and recommendations.
- 3.8 MANUAL PULL STATIONS
- A. Reference 3.01, General Installation Requirements.
 - B. Install per manufacturer's instructions and recommendations.
 - C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.
 - D. Provide protective guard where device is subject to abuse and where required by AHJ.
- 3.9 RELAY MODULES
- A. Reference 3.01, General Installation Requirements.
 - B. Install per manufacturer's instructions and recommendations.
 - C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.
- 3.10 CONTROL MODULES
- A. Reference 3.01, General Installation Requirements.
 - B. Install per manufacturer's instructions and recommendations.
 - C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.
- 3.11 INPUT MODULES
- A. Reference 3.01, General Installation Requirements.

- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.

3.12 FAULT ISOLATION MODULES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed address labels on addressable devices. Labels to be visible from the floor without magnification.
- D. Provide Fault Isolator Modules for signaling line circuit per code requirements and manufacturer instructions.

3.13 COMBINATION SPEAKER/STROBES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.
- D. Provide protective guard where device is subject to abuse and where required by AHJ.

3.14 STROBES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Provide machine printed labels on notification appliances with appliance circuit number and sequence. Labels to be visible from the floor without magnification.
- D. Provide wire guards or protective covers where device is subject to abuse and where required by AHJ.

3.15 MISCELLANEOUS ACCESSORIES

- A. Reference 3.01, General Installation Requirements.
- B. Install per manufacturer's instructions and recommendations.
- C. Weatherproof/Surface Backboxes: Provide manufacturer's weatherproof backbox listed for use in areas where the device or appliance is subject to humidity in excess of listed rating. Provide manufacturer surface backboxes where devices cannot be installed recessed.
- D. Protective Guard:
 - 1. Wire Guard.
 - 2. Protective Cover.
- E. Circuit Conductors: Provide wiring to meet the requirements of national, state and local electrical codes. Provide color coded wiring as recommended and specified by the fire alarm and detection system manufacturer. Provide Type FPLR cable when in a riser application or FPLP cable when installed in plenums.
- F. Surge Protection:
 - 1. Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral and 350 V(ac), line-to-line; do not use fuses.

- G. Document Storage Cabinet: Provide document storage cabinet adjacent to fire alarm control panel.
- H. Instruction Charts: Install chart adjacent to fire control unit.
- I. Framed Floor Map: Provide framed floor plan of facility adjacent to the annunciator panel identifying room names/numbers, device/addresses or fire zone number and description as utilized on the annunciator panel, as required by local AHJ. Check with the local fire department for size and approved mounting location.

END OF SECTION

SECTION 312000 - EARTHWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.

- B. Latest edition of the Arlington County Construction Standards and Specifications Manual and Construction Standards Detail.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Excavation, filling, backfilling, and grading indicated and necessary for proper completion of the work.
 - 2. Preparing of subgrade for pavements.
 - 3. Placement of aggregate sub base course for pavements and walks.
 - 4. Drainage/porous fill course for support of building slabs.
 - 5. Excavating and backfilling of trenches.
 - 6. Excavating and backfilling for underground mechanical and electrical utilities and buried mechanical and electrical appurtenances.

1.03 SUBMITTALS

- A. VDOT approved Job Mix for stone.
- B. Imported fill (if required): Submit location of borrow pit and a sample of the soil for approval to the Owner's Geotechnical Engineer a minimum of fourteen (14) working days prior to use
- C. Geotextile Fabric and Geogrids (if applicable).
- D. Copy of Blasting Permit, approved by authorities having jurisdiction, for record purposes.
- E. Copy of Pre-Blast Survey, for record purposes.
- F. Portland cement concrete or lean mix concrete mix designs.

1.04 DEFINITIONS

- A. Excavation: Removal of all material encountered to design subgrade elevations indicated for cut areas and to subsoil elevations in fill areas. Excavation also includes subsequent respreading, moisture conditioning, compaction, and grading of satisfactory materials removed.
- B. Unauthorized Excavation: Removal of materials beyond the limits indicated in the definition of "Excavation" without specific direction of Architect / Engineer.
- C. Additional Excavation: Removal, disposal and replacement of materials beyond the limits indicated in the definition of "Excavation" at the direction of the Architect / Engineer. Refer to Part 3 of this Section for requirements of Additional Excavation.
- D. Subgrade: The undisturbed earth (in cut) or the compacted soil layer (in fill) immediately below granular subbase, drainage fill, or topsoil materials.
- E. Subsoil: The undisturbed earth immediately below the existing topsoil layer.
- F. Building Pad: The area extending 10 feet beyond the exterior limits of the building/column footings and down to undisturbed soils at a one horizontal to one vertical slope.
- G. Structures: The area extending a minimum of ten (10) feet beyond the edge of foundations, slabs, curbs, underground tanks, piping or other man-made stationary features occurring above or below ground surface.
- H. Pavements: The area extending 10 feet beyond the exterior limits of paved areas and down to undisturbed soils at a one horizontal to one vertical slope. The area extending 3 feet beyond the exterior limits of walks and down to undisturbed soils at a one horizontal to one vertical slope
- I. Subbase Material: Artificially graded mixture of crushed gravel or crushed stone meeting VDOT specifications. Material type is indicated on the drawings.
- J. Drainage/Porous Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel meeting the requirements of VDOT No. 57 Stone.
- K. Rock: Hard bed rock, boulders or similar material requiring the use of rock drills and/or explosives for removal. The criteria for classification of general excavation as rock is any material which cannot be dislodged by a Caterpillar D-8 Tractor, or equivalent, equipped with a single tooth hydraulically operated power ripper. The criteria for trench rock shall be that a Caterpillar 345 Backhoe, or equivalent, with a proper width bucket cannot remove the material.

1.05 ADDITIONAL WORK

- A. This Project is Unclassified.
- B. The risks of concealed, unknown, or unanticipated subsurface conditions from existing ground surface to the design subgrade elevations in cut areas and to subsoil elevations in fill areas shall be included in the Contract Amount and shall not be considered as grounds for additional costs to the Contract.
- C. The risks of concealed, unknown, or unanticipated subsurface conditions below the elevations stated above identified as additional excavation shall also be included in the Base Bid Contract amount and shall not be considered as grounds for additional cost to the Contract. The work includes the establishment of acceptable bearing conditions in both cut and fill situations.
- D. Rock Excavation: Any required rock excavation shall be included in the Base Bid Contract amount and shall not be considered as grounds for additional costs to the Contract.
- E. Time extensions will not be granted for Additional Excavation or Rock Excavation.

1.06 EARTHWORK BALANCE ADJUSTMENTS

- A. *Adjustments of grades may be allowed with prior written approval of the Architect / Engineer in order to accommodate shortfall or surplus of material that may occur. Should adjustments be allowed, maintenance of designed drainage patterns and required adjustments to drainage structures shall be a Contract responsibility. No additional payment will be made for these adjustments.*
- B. Any surplus material remaining shall be removed from the site and disposed of in a legal manner.

1.07 QUALITY ASSURANCE

- A. *Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.*
- B. Environmental Compliance:
 - 1. Comply with the requirements of the latest edition of the Virginia Erosion and Sediment Control Handbook for erosion control during earthwork operations.
 - 2. Comply with the permit conditions for all work performed within wetlands.
- C. *Testing and Inspection Service: Owner will employ and pay for an independent Geotechnical testing and inspection laboratory to perform soil testing and inspection service during earthwork operations. Cooperate with Owner's Geotechnical Engineer as required for testing and inspection of work. These services do not relieve the responsibility for compliance with Contract Document requirements.*

1.08 PROJECT CONDITIONS

- A. Bidders and interested parties (prior to receipt of bids) are encouraged to conduct their own soil and subsurface investigations, examinations, tests, and exploratory borings to determine the nature of the soil conditions underlying the project site. Contact the Owner's office to make an appointment to enter the site for the purpose of conducting your own investigation prior to bid.
- B. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner of others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.
 - 1. Notify Architect / Engineer not less than 48 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without receiving Architect / Engineer's written permission.
 - 3. Existing utilities across or along the line of work are indicated only in an approximate location. Locate all underground lines and structures. Call "Miss Utility" at 1-800-552-7001 prior to construction. If utilities are marked that are not shown on the plans, locate utility vertically and horizontally and provide information to Architect / Engineer. Repair and correct any damage to underground lines and structures.

1.09 SAFETY

- A. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
 - 1. Operate warning lights as recommended by authorities having jurisdiction and governing regulations and standards.
 - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Work within the road right-of-way shall meet all requirements of the latest edition of the Virginia Department of Transportation Work Area Protection Manual.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups CL, GC, SC, GW, GP, GM, SM, SW, SP, and ML with a maximum Liquid Limit of 45 and a maximum Plasticity index of 20.
 - 1. Open graded materials (GW and GP), which contain void spaces in their mass should not be used in structural fills unless properly encapsulated with filter fabric.
- B. Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups CH, OL, OH, MH, and PT.
- C. Backfill and Fill Materials: Satisfactory soil materials free of clay, rock or gravel larger than 4 inches in any dimension (2 inches for material used in trench backfill), debris, waste, frozen materials, vegetation and other deleterious matter.
- D. Imported material for structural fill shall comply with ASTM D2487 soil classification groups CL, SC, SM, SP, SW, GC, GM, GP, ML or GW.

2.02 ACCESSORIES

- A. Non-woven Geotextile Fabric (for drainage): Mirafi 140N, or approved equivalent.
- B. Woven Geotextile Fabric (for reinforcement): AAMCO 2002, or approved equivalent.
- C. Geogrid: Tensar BX 1100 or approved equivalent.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Section 31 1000 "Site Clearing."

- C. Protect and maintain erosion and sedimentation controls during earthwork operations.

3.02 DEWATERING

- A. Prevent surface water and subsurface or groundwater from flowing into excavation area and/or ponding on project site and surrounding area.
1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrade and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
 2. Do not allow water to accumulate in trench excavations. Remove water to prevent softening of trench bottoms and soil changes detrimental to stability of pipe bedding. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from trench excavations.
 3. Establish and maintain temporary drainage ditches and other diversions outside excavation area to convey rain water and water removed from excavations to collecting or runoff areas. Do not use utility trench excavations as temporary drainage ditches.
- B. Should any springs or groundwater surface within the project excavation, notify the Architect and provide discharge by trenches (or other acceptable means) and drain to an appropriate point of disposal. Repair any damage to property or to subgrade as a result of construction and/or dewatering (or lack thereof) operations at no additional cost to the Contract. If permanent provision must be made for disposal of water other than as indicated, the Contract price shall be adjusted.
- C. Soils encountered may require disking, scarifying, moisture conditioning, harrowing, pulverizing, or other special or careful handling when utilized as fill. No additional payment will be made for these operations.

3.03 EXPLOSIVES

- A. Blasting may be done only if authorized by the Owner and local authorities having jurisdiction. When explosives are used, experienced powder men or persons who are licensed or otherwise authorized to use explosives shall execute the work. Explosives shall be stored, handled, and used in accordance with local regulations and with the "Manual of Accident Prevention in Construction" of the Associated General Contractor of America, Inc. Meeting the requirements of the blasting permit, if issued, is a Contract responsibility.
1. Pre-blast inspections are required in accordance with all prevailing jurisdictional guidelines. These inspections and associated costs are the sole responsibility of the Contractor. Any damage resulting from blasting operations to onsite or off site structures and appurtenances and costs associated therewith are the sole responsibility of the Contractor. Blasting operations in the vicinity of existing structures and new and/or in-progress construction shall also be performed in accordance with the constraints of the most recent edition of the Virginia Statewide Fire Prevention Code, NFPA 495 and/or local ordinances as applicable.

3.04 EXCAVATION

- A. Excavation consists of removal, placement and disposal of material encountered when establishing required subgrade or finish grade elevations.
1. Excavation includes removal and disposal of pavements and other obstructions visible on ground surface; underground structures, utilities and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.
- B. Rock Excavation:
1. If rock is encountered in grading, remove to depths as follows:
 - a) Under surfaced areas, to 6" under the respective subgrade for such areas.
 - b) Under grass and planted areas - 12" minimum.
 - c) Under footings – Two feet below bottom of footing, One foot outside of perimeter of footing.
 - d) Under trenches – 6" below bottom of trench.

3.05 EXCAVATION FOR BUILDING PAD AND STRUCTURES

- A. Conform to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction and for review.
- B. Excavations for footings and foundations: Do not disturb bottoms of excavation. Excavate by hand to elevations required just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.
- C. Where rock is encountered, carry excavation to required elevations and backfill with crushed stone prior to installation of footing.
- D. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Structures: Conform to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction and for review. Do not disturb bottom of excavations intended for bearing surface.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Cut surface under pavements to comply with cross-sections, elevations and grades as indicated.

3.07 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches of clearance on both sides of pipe or conduit.
- B. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

1. Where rock is encountered, carry excavation to required elevations and backfill with VDOT #57 crushed stone prior to installation of pipe.
2. For pipes or conduit less than 6 inches in nominal size, and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths. Hand-excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.
3. For pipes and equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90 degrees (bottom 1/4 of the circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads ensure continuous bearing of pipe barrel on bearing surface.

3.08 EXCAVATION STABILITY

- A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
- B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.09 SUBGRADE INSPECTION

- A. Notify Architect / Engineer when mass, trench and footing excavations have reached required subgrade. The Architect / Engineer will arrange for an inspection of conditions by the Owner's Geotechnical Engineer. *Alternative procedures for arranging this review may be implemented at the Owner's written option.*
- B. If the Owner's Geotechnical Engineer determines that the subgrade bearing conditions are unacceptable, the Architect / Engineer will authorize additional excavation until suitable bearing conditions are encountered.
- C. Proof-roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction[, repeating proof-rolling in direction perpendicular to first direction]. Limit vehicle speed to **3 mph (5 km/h)**.
 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than **15 tons (13.6 tonnes)**.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect / Engineer, and replace with compacted backfill or fill as directed.
- D. Under supervision of the Owner's Geotechnical Engineer, proofroll subgrade in cut areas below the building pad and pavement(s) with a loaded dump truck or other approved pneumatic tired vehicle. Should any unstable sub-soil be encountered below pavement or structures, break up the top eight inches of ground surface, pulverize, moisture-condition to optimum moisture content, and compact

to percentage of maximum density as stated in Percentage of Maximum Density Requirements. Perform this work at no additional cost and/or time to the Contract.

- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect / Engineer, without additional compensation.

3.10 ADDITIONAL EXCAVATION

- A. Additional Excavation (Mass): Remove excavated materials and dispose of on-site as directed by the Architect / Engineer. Replace this excavated material with satisfactory material placed and compacted according to the requirements of the "Placement and Compaction" section.
- B. Additional Excavation in Trenches: Remove excavated materials and dispose of on-site as directed by the Architect / Engineer. Replace this excavated material with stone.
- C. Additional Excavation in Footings: Remove excavated materials and dispose of on-site as directed by the Architect / Engineer. Replace this excavated material with lean concrete/flowable fill or with stone extending 12 inches laterally beyond the footing in all directions.
- D. Protect the subgrade during construction. During wet conditions, the subgrade soils may become saturated and soften, possibly resulting in damage to the subgrade if disturbed by equipment. Correct subgrade damaged in this manner. No additional payment will be made to correct subgrade damaged in this manner.

3.11 UNAUTHORIZED EXCAVATION

- A. Correct Unauthorized Excavation as follows:
 - 1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to Architect / Engineer.
 - 2. Elsewhere, backfill and compact unauthorized excavations as indicated for authorized excavations of same classification unless otherwise directed by Architect / Engineer.

3.12 STORAGE OF EXCAVATED MATERIALS

- A. Temporarily stockpile excavated materials acceptable for use as backfill and fill. Place, grade, and shape stockpiles for proper drainage. Cover to prevent windblown dust.
 - 1. Stockpile excavated materials away from edge of excavations. Do not store within the drip line of trees to remain.

3.13 BACKFILL AND FILL

- A. *Backfill excavations as promptly as work permits, but not until completion of the following:*
 - 1. Acceptance by local authority having jurisdiction of construction below finished grade, including perimeter insulation.
 - 2. Review, approval, and recording of the locations of underground utilities.

3. Removal of concrete formwork.
 4. Removal of shoring and bracing (including backfilling of voids with satisfactory materials).
 5. Removal of trash and debris from excavation.
 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow or ice.
- C. Ground Surface Preparation: Remove vegetation, debris, obstructions, and deleterious materials from ground surface prior to placement of fills.
- D. Bench sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material. Plow, scarify, bench or break up sloped surfaces flatter than 1 vertical to 4 horizontal so fill material will bond with existing material.
- E. Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials indicated in Part 2 of this Section.
1. Under grassed areas, use satisfactory excavated or borrow material.
 2. Under walks, curbs, and pavements, use satisfactory excavated or borrow material.
 3. Under building slabs, use satisfactory excavated or borrow materials and drainage/porous fill material as indicated.

3.14 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.
- D. Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit.
- G. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- H. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

- J. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
- K. Do not backfill trenches until any required testing and inspections have been completed and Architect / Engineer authorizes backfilling. Backfill carefully to avoid damage or displacement of pipe systems.
- L. Under piping and conduit and equipment, use crushed stone where required over rock bearing surface and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90 degrees of cylinder.
- M. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

3.15 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percentage points of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percentage points and is too wet to compact to specified dry unit weight.
- B. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations. Maintain the moisture content of the structural fill materials to within 2 percentage points of the optimum moisture content until permanently covered.
- C. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to required density.
 - 1. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.
 - 2. Work wet materials as directed by the Owner's Geotechnical Engineer. Base bids on working material daily for a maximum of five days of acceptable weather.
 - 3. No additional payment will be made for these operations.
 - 4. Time extensions will not be granted for working wet material on site.

3.16 COMPACTION OF SOIL BACKFILL AND FILLS

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each

area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

- C. Control soil and fill compaction, providing minimum percentage of density indicated for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Architect / Engineer if soil density tests indicate inadequate compaction.
- D. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density at a moisture content within 2 percentage points of optimum in accordance with ASTM D698:
 - 1. Under structures, building pad and pavements, compact each layer of backfill or fill material at 95 percent maximum density. This includes ground under future expansion areas.
 - 2. Under grass or unpaved areas, compact each layer of backfill or fill material at 90 percent maximum density.
- E. Seal all fill areas at the end of each working day, utilizing a smooth drum roller.

3.17 GRADING

- A. General: Rough grading of areas within the Project, including cut and fill sections and adjacent transition areas, shall be reasonably smooth, compacted and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from either blade-grader or motor patrol except as otherwise indicated. The finished subgrade surface from the grassed areas generally shall be not more than 0.2 feet above or below the final grade or approved cross section, with due allowance for topsoil.
- B. The tolerance for areas within 10 feet of building perimeter, walks and all areas to be paved shall not exceed 0.10 feet above or below the established subgrade. Finish all ditches, swales and gutters to drain readily. Unless otherwise indicated, evenly slope the subgrade to provide drainage away from building walls in all directions at a grade not less than $\frac{1}{4}$ inch per foot. Provide rounding at top and bottom of cut and fill slopes and at other breaks in grade.
- C. Protection of Graded Areas: Protect newly graded areas and areas of cut, fill and design/subgrade elevations from the actions of the elements and from deterioration as a result of construction operations and weather conditions (frost, rains, snow, sleet, hail, etc.). Repair any settlement or washing that occurs prior to or after acceptance of the work. Fill to required subgrade levels any areas where settlement occurs. Protect trees to remain, and, at all areas of the Site where construction operations are in progress, provide protection for the safety of occupants of the existing facilities.
- D. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- E. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch
 - 2. Walks: Plus or minus 1 inch.

3. Pavements: Plus or minus 1/2 inch .
- F. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot . straightedge.

3.18 PAVEMENT SUBBASE COURSE:

- A. General: Place subbase material, in layers of indicated thickness, over subgrade surface to support a pavement base course.
- B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.
- C. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least at 12" width of shoulder simultaneously with compacting and rolling each layer of subbase course.
- D. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
- E. When a compacted subbase course is 6 inches thick or less, place material in a single layer. When more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inch thickness when compacted.
- F. Place base course on subgrades free of mud, frost, snow, or ice.
- G. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 1. Place base course material over subbase course under hot-mix asphalt pavement.
 2. Shape base course to required crown elevations and cross-slope grades.
 3. Place base course 6 inches or less in compacted thickness in a single layer.
 4. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 5. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 100 percent of maximum dry unit weight according to ASTM D 698.
- H. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 100 percent of maximum dry unit weight according to ASTM D 698.

3.19 BUILDING SLAB DRAINAGE COURSE

- A. General: Place drainage/porous fill material, over subgrade surface to support concrete building slabs and sidewalks areas indicated.
- B. Place drainage course on subgrades free of mud, frost, snow, or ice.

- C. Placing: Place drainage/porous fill material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting material during placement operations.
- D. When a compacted drainage course is indicated to be 6 inches thick or less, place material in a single layer. When indicated to be more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inches in thickness when compacted.

3.20 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.
 - 1. If in the opinion of the Architect / Engineer, based on testing service reports and inspection, subgrade or fills have been placed that are below required density, perform additional compaction and testing until required density is obtained.
- B. The Owner will engage, and pay for, the services of a Geotechnical Engineer whose function shall be to afford complete engineering control by testing of the conditions of all footing subgrades, the placement of all structural fills under structures, building pad and pavement areas, and all compaction where required, and to observe the proof rolling of the building pad and pavement areas.
- C. The Owner's Geotechnical Engineer will be present as deemed necessary during all phases of the Work requiring filling, compaction operations or testing. The Geotechnical Engineer will provide the Architect / Engineer with written certification that fill and compaction was completed with accepted materials in accordance with the Documents, and give a professional opinion regarding shrinkage or settlement of fill and safe load bearing capacity of fill.
- D. Site Preparation and Proofrolling: The Owner's Geotechnical Engineer will determine if any additional excavation or in-place densification is necessary to prepare a subgrade for fill placement for slab or pavement support.
- E. Fill Placement and Compaction: The Owner's Geotechnical Engineer will witness all fill operations and take sufficient in-place density tests to verify that the indicated degree of fill compaction is achieved. The Owner's Geotechnical Engineer will observe and approve borrow materials used and shall determine if their existing moisture contents are suitable/acceptable.
- F. Footing Excavation Review: The Owner's Geotechnical Engineer will review the footing excavations for the building foundations. He will verify that the design bearing pressures are available and that no loose or soft areas exist beneath the bearing surfaces of the footing excavations.
- G. The Owner's Geotechnical Engineer will submit two (2) copies each of his reports, recommendations and/or opinions to the Architect/Engineer and the Owner. Pertinent information will be provided to the Contractor as required.

3.21 EROSION CONTROL:

- A. Provide erosion control methods in accordance with requirements of authorities having jurisdiction, the Virginia Erosion and Sediment Control Handbook, and as indicated in the Contract Documents.

3.22 PROTECTION

- A. Repair and reestablish grades in settled, eroded, and rutted areas to indicated tolerances.
- B. Reconditioning Compacted Areas: Where subsequent construction operations or adverse weather disturbs completed compacted areas, scarify surface, reshape, and compact to required density prior to further construction.
- C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- D. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.23 DISPOSAL OF WASTE MATERIALS

- A. Removal from Owner's Property: Remove excess and/or waste materials, including trash and debris, and dispose of it off Owner's property in a legal manner.
- B. Dispose of excess material and materials not acceptable for use as backfill or fill legally offsite.
- C. Do not remove topsoil from site until it has been demonstrated to the Owner's satisfaction that it is excess.

END OF SECTION 312000

SECTION 312500 - EROSION CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS:

- A. The provisions of the Contract Documents apply to the work of this Section.
- B. The Virginia Erosion and Sediment Control Handbook, latest edition.
- C. Latest edition of the Arlington County Construction Standards and Specifications Manual and Construction Standards Detail.

1.02 SUMMARY

- A. This Section includes the installation, maintenance and removal of erosion control measures required for prevention of sediment leaving the project site.
- B. This Section also includes the requirement to file the Virginia Stormwater Management Program (VSMP) General Permit Registration Statement for Storm Water Discharges from Construction Activities with the Virginia Department of Conservation and Recreation (DCR).

1.03 EROSION AND SEDIMENT CONTROL PERMIT

- A. Prior to commencement of work, obtain a copy of the approved Erosion and Sediment Control Plan from the Owner.
- B. Apply for the Land Disturbance Permit (if required). The contractor shall have a Registered Land Disturber on staff at time of bid award and on site during the entire project. The Grading Permit / Land Disturbance Permit will be assigned to that individual.
- C. Post Erosion and Sediment Control Bond (if required).
- D. Schedule a pre-construction conference on-site with the Owner, Architect, Engineer and DCR. Hold this meeting prior to the start of any construction activities.

1.04 VSMP REGISTRATION

- A. Prior to commencement of work, transfer the existing registration for the site with the State Department of Environmental Quality (DEQ) per the requirements of the Virginia Stormwater Management Program (VSMP). **The site must be registered to the Contractor's Responsible Land Disturber prior to the start of construction activities.** Contractor is responsible for all VSMP related fees and complying with the requirements of the permit.
- B. During construction, the following requirements shall be met:
 - 1. A copy of the Stormwater Pollution Prevention Plan (SWPPP) shall be kept at the job site at all times.
 - 2. Amend the SWPPP as necessary to account for significant changes in design, construction or maintenance that would increase the pollution potential of the site. File a copy of the amended plan with DEQ and with the Architect.
 - 3. The Responsible Land Disturber shall perform weekly inspections of the erosion and sediment control measures. Inspection reports shall be filed as an appendix to the SWPPP.
 - 4. Contractor is responsible for required VSMP renewals.

- C. Following final acceptance of the site by the Owner and sign off by the County Environmental Inspector, file a Notice of Termination with the Virginia Department of Environmental Quality.

1.05 SUBMITTALS

- A. Responsible Land Disturber registration information.
- B. A copy of the VSMP registration application and a copy of the Stormwater Pollution Prevention Plan.
- C. Copies of the weekly Erosion Control Measure inspection reports. *These may be submitted at the progress meetings.*
- D. Silt Fence Specifications
- E. Safety Fence Specifications
- F. Super Silt Fence Specifications (if applicable).
- G. Specifications of all E&S control measure structures used on site.

1.06 PAYMENT PROCEDURES FOR EROSION CONTROL MEASURES

- A. Establish a line item in the Schedule of Values for Erosion Control Maintenance. This line item shall represent a minimum of thirty percent (30%) of the total value of the erosion control for the project.
- B. Erosion control maintenance will be paid on a monthly basis, following the satisfactory installation and maintenance of the erosion control measures.
- C. Erosion control maintenance Contract shall include all additional erosion control products and structures and their installations if additional items beyond those specified on the Contract documents.

PART 2 PRODUCTS

2.01. EROSION CONTROL PRODUCTS:

- A. Safety Fence
 - 1. Six foot high chain link fence, complying with the requirements of Standard and Specification 3.01 of the Virginia Erosion and Sediment Control Handbook. Fencing to have moveable panels for relocation denoted with the required phasing plans.
 - 2. Fencing to be provided as required by the phasing plans and as follows:
 - a) At a minimum the all buildings under construction shall be surrounded with safety fence included with appropriate lockable access gates for material, labor and equipment. Also all construction trailers, staging areas and material storage areas shall be surrounded with safety fence at all times during construction.
 - b) Work performed near existing buildings to remain during construction shall be surrounded with safety fence to protect students, pedestrians and traffic. Proper sigs shall be utilized to keep unauthorized personnel out of construction areas.
 - c) Post appropriate warning signs along the Safety Fence.

B. Construction Entrance

1. Heavy-duty stone aggregate and filter fabric construction entrance, complying with the requirements of Standard and Specification 3.02 of the Virginia Erosion and Sediment Control Handbook.
2. Reinforced concrete wash-rack, draining to a sediment trap.
3. The water source for washing operations shall be the responsibility of the Contractor.

C. Silt Fence

1. Synthetic filter fabric, complying with the requirements of Standard and Specification 3.05 of the Virginia Erosion and Sediment Control Handbook.
2. Wooden stakes shall be 2" oak, a minimum length of five feet.

D. Super Silt Fence

1. Synthetic filter fabric, complying with the requirements of Standard and Specification 3.05 of the Virginia Erosion and Sediment Control Handbook.
2. Galvanized metal posts, a minimum length of 7.67 feet.
3. Wire fence reinforcement shall be a minimum of 14-gauge and have a maximum mesh spacing of six inches.

E. Storm Drain Inlet Protection

1. Block and Gravel Drop Inlet Sediment Filter, complying with the requirements of Standard and Specification 3.07 of the Virginia Erosion and Sediment Control Handbook.
2. Block and Gravel Curb Inlet Sediment Filter, complying with the requirements of Standard and Specification 3.07 of the Virginia Erosion and Sediment Control Handbook.

F. Temporary Diversion Dike

1. Berm of compacted soil material, stabilized with vegetation, complying with the requirements of Standard and Specification 3.09 of the Virginia Erosion and Sediment Control Handbook.

G. Temporary Fill Diversion

1. A channel with a berm on the lower side, placed at the top of a fill slope, complying with the requirements of Standard and Specification 3.10 of the Virginia Erosion and Sediment Control Handbook.

H. Diversion

1. A channel with a berm on the lower side, stabilized with vegetation, complying with the requirements of Standard and Specification 3.12 of the Virginia Erosion and Sediment Control Handbook.

I. Outlet Protection

1. A level area of riprap, placed over filter fabric, complying with the requirements of Standard and Specification 3.18 of the Virginia Erosion and Sediment Control Handbook.

J. Riprap

1. Graded stone, placed over filter fabric, complying with the requirements of Standard and Specification 3.19 of the Virginia Erosion and Sediment Control Handbook.

2. The size of the stone required is indicated on the Contract documents.
- K. Rock Check Dams
1. Temporary stone dams constructed across a swale or ditch, complying with the requirements of Standard and Specification 3.20 of the Virginia Erosion and Sediment Control Handbook.
 2. Check dams shall be placed on filter fabric.
- L. Dewatering Structure
1. A temporary filtering device used for dewatering operations, complying with the requirements of Standard and Specification 3.26 of the Virginia Erosion and Sediment Control Handbook.
- M. Temporary Seeding
1. Temporary vegetative cover for disturbed areas, complying with the requirements of Standard and Specification 3.31 of the Virginia Erosion and Sediment Control Handbook.
- N. Permanent Seeding
1. Refer to Section 32 9200 "Landscaping" for permanent seeding requirements.

PART 3 EXECUTIONS

3.01 INSTALLATION OF EROSION CONTROL MEASURES

- A. Install all erosion and sediment control measures per the requirements of the Virginia Erosion and Sediment Control Handbook.
- B. Protect all points of construction ingress and egress to the site to prevent tracking of mud onto public streets. Provide temporary construction entrances at all points of access to the site.
- C. Clear only those areas necessary for installation of the perimeter erosion control measures. The balance of the site shall not be cleared or otherwise disturbed until the perimeter erosion control measures are installed and functional.
- D. Follow the construction sequence and install erosion control measures as indicated on the Contract documents and as directed by the Owner.
- E. Install additional measures as necessary to prevent sediment from leaving the project site.

3.02 MAINTENANCE OF EROSION CONTROL MEASURES

- A. Maintain all erosion and sediment control measures per the requirements of the Virginia Erosion and Sediment Control Handbook.
- B. At a minimum, the following maintenance is required:
 1. Safety Fence
 - a. Review fence regularly for damage. Repair any damage immediately.
 - b. Secure the fence at the end of each working day. Repair or replace all locking devices as necessary.
 2. Construction Entrance
 - a. Wash and rework stone and/or place additional stone as required preventing tracking of

- mud onto the roadways.
 - b Clean out the sediment-trapping device for the wash rack.
 - c Remove all materials spilled, dropped, washed or otherwise tracked onto roadways or into storm sewers immediately. Do not use water trucks to wash the roadways.
3. Silt Fence
- a Inspect immediately following each rainfall and at least daily during prolonged rainfall.
 - b Make any required repairs immediately. Give special attention to damage resulting from end-runs and undercutting.
 - c Replace fabric that is decomposing or is otherwise ineffective.
 - d Clean out accumulated sediment following every storm event. Do not allow sediment to accumulate higher than one-half the height of the barrier.
4. Super Silt Fence
- a Inspect immediately following each rainfall and at least daily during prolonged rainfall.
 - b Make any required repairs immediately. Give special attention to damage resulting from end-runs and undercutting.
 - c Replace fabric that is decomposing or is otherwise ineffective.
 - d Clean out accumulated sediment following every storm event. Do not allow sediment to accumulate higher than one-half the height of the barrier.
5. Storm Drain Inlet Protection
- a Inspect immediately following each rainfall and at least daily during prolonged rainfall.
 - b Remove and clean or replace stone filters that have been clogged with sediment. Make any required repairs immediately
 - c Remove accumulated sediment as required. Do not allow sediment to accumulate higher than one-half the height of the measure.
6. Temporary Diversion Dike
- a Inspect immediately following each rainfall and at least daily during prolonged rainfall. Inspect at least once every two weeks, whether or not it has rained. Make any necessary repairs immediately.
 - b Repair damages caused by construction activities by the end of each working day.
7. Temporary Fill Diversion
- a Review measure at the end of each working day to ensure its effective operation.
8. Diversion
- a Inspect diversion following every rainfall and at least once every two weeks.
 - b Remove accumulated sediment and make repairs as necessary.
 - c Re-seed as necessary to maintain vegetative cover.
9. Outlet Protection

- a Inspect outlet protection following every storm event. Re-lay riprap as necessary to prevent concentrated flow from running across the outlet protection.
10. Riprap
- a Inspect riprap following every storm event. Re-lay riprap as necessary to prevent concentrated flow from running under or around the riprap.
 - b Clean out accumulated sediment from the riprap.
11. Rock Check Dams
- a Inspect immediately following each rainfall and at least daily during prolonged rainfall.
 - b Remove and clean or replace stone that has been clogged with sediment.
 - c Inspect for evidence of by-pass flows. Make any required repairs immediately
 - d Remove accumulated sediment as required. Do not allow sediment to accumulate higher than one-half of the height of the dam.
12. Dewatering Structure
- a Repair or replace the filtering media to prevent sediment accumulation from affecting the filtering capacity of the structure.
13. Temporary Seeding
- a Re-seed and mulch areas where cover is inadequate to protect against erosion until adequate cover is obtained.
- C. Remove accumulated sediment as required and at appropriate intervals to maintain the effective function of all erosion control measures.
- D. Inspect, repair and remove accumulated sediment from erosion control measures following significant (greater than ½”) rainfall events.
- E. If erosion control measures become clogged, causing the impoundment of water, restore the measures immediately. Ponding water poses a potential drowning hazard and shall be relieved immediately by either pumping (through an approved dewatering structure) or by removal of the blockage.

3.03 REMOVAL OF EROSION CONTROL MEASURES

- A. Remove all temporary erosion control measures following the stabilization of the site. Do not remove erosion control measures until authorized by the Owner.
- B. Topsoil, permanently seed and stabilize areas occupied by erosion control measures.

END OF SECTION 312500

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Posts, rails, and frames.
- B. Wire fabric.
- C. Concrete.
- D. Manual gates with related hardware.
- E. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete anchorage for posts.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- D. ASTM F567 - Standard Practice for Installation of Chain-Link Fence 2014a.
- E. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric 2017.
- F. CLFMI CLF-SFR0111 - Security Fencing Recommendations 2014.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.
- D. Samples: Submit two samples of fence fabric, 12 inch by 12 inch in size illustrating construction and colored finish.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Fence Installer: Company with demonstrated successful experience installing similar projects and products, with not less than five years of documented experience.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Posts, Rails, and Frames:
 - 1. Formed from hot-dipped galvanized steel sheet, ASTM A653/A653M, HSLAS, Grade 50, with G90 (Z275) zinc coating.
 - 2. Line Posts: Type I round.
 - 3. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round.
- B. Wire Fabric:
 - 1. ASTM F668 polymer-coated steel chain link fabric.
- C. Concrete:
 - 1. Type specified in Section 03 30 00.

2.2 COMPONENTS

- A. Line Posts: 1.9 inch diameter.
- B. Corner and Terminal Posts: 2.38 inch diameter.
- C. Gate Posts: 3-1/2 inch diameter.
- D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
- E. Bottom Rail: 1.66 inch diameter, plain end, sleeve coupled.
- F. Gate Frame: 1.66 inch diameter for welded fabrication.
- G. Fabric: 2 inch diamond mesh interwoven wire, 6 gage, 0.1920 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.
- H. Tension Wire: 6 gage, 0.1920 inch thick steel, single strand.

2.3 MANUAL GATES AND RELATED HARDWARE

- A. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

2.4 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
- C. Mounting Plates: As required for mounting fencing to existing concrete slab on grade.

2.5 FINISHES

- A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot.
- B. Components and Fabric: Vinyl coated over coating of 1.8 ounces per square foot galvanizing.
- C. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
- D. Accessories: Same finish as framing.
- E. Color(s): To be selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that areas are clear of obstructions or debris.

3.2 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
 - 1. Mount to slab with base plate where indicated.
- D. Line Post Footing Depth Below Finish Grade: ASTM F567.
- E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.
- F. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.
- G. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
- H. Do not stretch fabric until concrete foundation has cured 28 days.
- I. Position bottom of fabric 2 inches above finished grade.
- J. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- K. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- L. Install bottom tension wire stretched taut between terminal posts.
- M. Do not attach the hinged side of gate to building wall; provide gate posts.
- N. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

3.3 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Position: 1 inch.

3.4 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- B. Clean fence with mild household detergent and clean water rinse well.

END OF SECTION

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SECTION 321216 - ASPHALT PAVEMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.
- B. Latest edition of the Arlington County Construction Standards and Specifications Manual and Construction Standards Detail.
- C. Latest edition of the VDOT Road and Bridge Standards and Specifications.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hot-mix asphalt paving over prepared subbase.
 - 2. Hot –mix asphalt patching.
 - 3. Asphalt surface treatments
 - a) Coal tar sealant

1.03 SUBMITTALS

- A. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- B. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.
- C. Traffic maintenance and Work Area Protection Plan: Submit a plan indicating sequencing and measures to be used for the maintenance and protection of traffic during operations within or immediately adjacent to existing roadways open to vehicular traffic. The Architect and the Virginia Department of Transportation must approve this plan prior to commencement of work within the Right-of-Way.
- D. Geotextile Fabric
- E. Experience History and References for Paving Subcontractor

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Asphalt paving materials and installation shall conform to the requirements of the latest edition of the Virginia Department of Transportation (VDOT) Road and Bridge Specifications and Road and Bridge Standards.

1.05 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
 - 1. Prime and Tack Coats: Minimum ambient temperature of 50 deg F (10 deg C), and when temperature has not been below 35 deg F (1 deg C) for 12 hours immediately prior to application.
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.

1.06 TESTING AND INSPECTION

- A. Within the road Right-of-Way and in the bus loop, VDOT inspectors shall observe the asphalt placement. Coordinate the necessary inspection schedule with the local VDOT Residency.
- B. The Owner's testing agency will observe the asphalt placement in the parking lots and on-site areas not in Right-of-Way.

PART 2 PRODUCTS

2.01 ASPHALT-AGGREGATE MIXTURE

- A. General: Provide plant-mixed, hot-laid asphalt-aggregate mixture complying with the requirements of the VDOT Road and Bridge Specifications and as recommended by local paving authorities to suit project conditions.

2.02 ASPHALT MATERIALS

- A. Tack Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

2.03 AUXILIARY MATERIALS

- A. Paving Geotextile: Nonwoven polypropylene, specifically designed for paving applications, resistant to chemical attack, rot, and mildew.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- C. Notify Architect in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been satisfactorily corrected.

3.02 MAINTENANCE AND PROTECTION OF TRAFFIC

- A. Utilize flagmen, barricades, warning signs and warning lights as required by the VDOT Work Area Protection Manual.

3.03 PATCHING AND REPAIRS

- A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Re-compact new subgrade. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
 - 1. Tack coat faces of excavation and allow to cure before paving.
 - 2. Fill excavation with dense-graded, hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.
- B. Leveling Course: Install and compact leveling course consisting of dense-graded, hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.
- C. Crack and Joint Filling: Remove existing filler material from cracks or joints to a depth of 1/4 inch (6 mm). Refill with asphalt joint-filling material to restore watertight condition. Remove excess filler that has accumulated near cracks or joints.
- D. Tack Coat: Apply uniformly to existing surfaces of previously constructed asphalt (any asphalt placed more than three days prior) or Portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.
 - 1. Thoroughly clean surface prior to placement of tack coat.
 - 2. Allow tack coat to cure undisturbed before paving.
 - 3. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillage and clean affected surfaces.

3.04 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

3.05 GEOTEXTILE INSTALLATION

- A. Apply bond coat, consisting of asphalt cement, uniformly to existing surfaces at a rate of 0.20 to 0.30 gal./sq. yd. (0.8 to 1.2 L/sq. m).
- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches (100 mm) and transverse joints 6 inches (150 mm).
 - 1. Protect paving geotextile from traffic and other damage and place overlay paving the same day.

3.06 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt mix on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness, when compacted.
 - 1. Place hot-mix asphalt base course in number of lifts and thickness indicated.

2. Spread mix at minimum temperature of 225 deg F (107 deg C).
- B. Place paving in consecutive strips not less than 10 feet (3 m) wide, except where infill edge strips of a lesser width are required.
 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete asphalt base course for a section before placing intermediate or surface courses.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.
- D. Apply a tack coat between asphalt layers if more than 3 days passes between placement of layers or if temperatures have cooled to a point that adequate bonding between the layers can not be achieved.

3.07 JOINTS

- A. Construct joints between old and new pavement, or between successive days work, to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
 1. Clean contact surfaces and apply tack coat.
 2. Offset longitudinal joints in successive courses a minimum of 6 inches (150 mm).
 3. Offset transverse joints in successive courses a minimum of 24 inches (600 mm).
 4. Construct transverse joints as required by the VDOT Road and Bridge Specifications.
 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

3.08 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with hot-mix asphalt, and rerolling to required elevations.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling, while hot-mix asphalt is still hot enough to achieve indicated density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 1. Average Density: 95 percent of reference laboratory density according to ASTM D 1559.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm. Surface course average density shall be 95 percent of reference laboratory density.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly

using tamper or other satisfactory method. Edges adjacent to curbs and curb and gutter sections shall be flush with the edge of concrete.

- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials. Remove paving course over area affected and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.09 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch (13 mm).
 - 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch (6 mm).
 - 2. Surface Course: 3/16 inch (3 mm).
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).
- C. Check surface areas at intervals as directed by Architect.

3.010 FIELD QUALITY CONTROL

- A. Within the VDOT Right-of-Way, coordinate required inspections with the local VDOT Residency of the Virginia Department of Transportation.
- B. Testing Agency: Owner will engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with requirements.
- D. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with requirements.

END OF SECTION 321216

SECTION 321313 - SITE CONCRETE

PART 1 GENERAL

1.01. RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.
- B. Latest edition of the Arlington County Construction Standards and Specifications Manual and Construction Standards Detail.
- C. Latest edition of the VDOT Road and Bridge Standards and Specifications.

1.02. DESCRIPTION OF WORK:

- A. Extent of Portland cement concrete paving is shown on drawings, including but not limited to:
 - 1. Curbs and gutters
 - 2. Walkways
 - 3. Storm Outfall structures.
 - 4. Fencing
 - 5. Bollards
 - 6. Site Utilities
 - 7. Site Furnishings (i.e. Flagpoles, Bike Racks, etc.)

1.03. SUBMITTALS

- A. Provide certification that all materials meet VDOT standards for the class of concrete required.
- B. Expansion joint sealant material.

1.04. JOB CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 PRODUCTS

2.01. MATERIALS

- A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
 - 1. Use flexible spring steel forms or laminated boards to form radius bends as required.
 - 2. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.
- B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A 185.
- C. Reinforcing Steel: ASTM A 615, Grade 60, deformed

- D. Concrete Materials: Comply with requirements of the VDOT Road and Bridge Specifications for concrete materials, admixtures, bonding materials, curing materials, and others as required.
- E. Expansion Joint Materials: Comply with requirements of applicable Division 7 sections for preformed expansion joint fillers and sealers.
- F. Antispalling Compound: Combination of boiled linseed oil and mineral spirits, complying with AASHTO M-233.
- G. Liquid-Membrane Forming and Sealing Curing Compound: Comply with VDOT Road and Bridge Specifications.

2.02. CONCRETE MIX, DESIGN, AND TESTING

- A. Comply with requirements of applicable Division 3 sections for concrete mix design, sampling and testing, and quality control or VDOT Road and Bridge Specifications whichever is more stringent.
- B. Design mix to produce normal-weight concrete consisting of Portland cement, aggregate, water-reducing or high-range water-reducing admixture (superplasticizer), air-entraining admixture, and water to produce the following properties:
 - 1. Comply with the requirements of VDOT Std. Class A3 Concrete, unless otherwise indicated.

PART 3 EXECUTIONS

3.01. SURFACE PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Proof-roll prepared subbase surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving,

3.02. FORM CONSTRUCTION

- A. Set forms to required grades and lines, braced and secured. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.
- B. Check completed formwork for grade and alignment to following tolerances:
 - 1. Top of forms not more than 1/8 inch in 10 feet.
 - 2. Vertical face on longitudinal axis, not more than 1/4 inches in 10 feet.
- C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.03. REINFORCEMENT

- A. Locate, place and support reinforcement as specified in Division 3 sections, unless otherwise indicated.

3.04. CONCRETE PLACEMENT

- A. General: Comply with requirements of applicable Division 3 sections for mixing and placing concrete or VDOT Road and Bridge Specifications whichever is more stringent.
- B. Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Do not

place concrete around manholes or other structures until they are at required finish elevation and alignment.

- C. Place concrete by methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.
- D. Deposit and spread concrete in a continuous operation between transverse joints as far as possible. If interrupted for more than 1/2 hour, place a construction joint.
- E. Fabricated Bar Mats: Keep mats clean and free from excessive rust, and handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.
- F. Set reinforcing bars or mats on chair supports to the required depth below finish surface.
- G. Place concrete in a single pour, strike off, and screed.
- H. Remove and replace portions of bottom layer of concrete that have been placed more than 15 minutes without being covered by top layer or use bonding agent if acceptable to Architect.
- I. Curbs and Gutters: Automatic machine may be used for curb and gutter placement. If machine placement is to be used, submit revised mix design and laboratory test results that meet or exceed minimums indicated. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as indicated for formed concrete. If results are not acceptable, remove and replace with formed concrete meeting requirements.

3.05. JOINTS

- A. General: Construct expansion, weakened-plane (contraction), and construction joints true to line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.
- B. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas as shown on drawings. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, as follows:
 - 1. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
 - 2. Sawed Joints: Form weakened-plane joints with powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
 - 3. Inserts: Use embedded strips of metal or sealed wood to form weakened-plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.
- C. Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for more than 1/2 hour, except where such placements terminate at expansion joints.
 - 1. Construct joints as indicated or, if not indicated, use standard metal keyway-section forms.
 - 2. Coordinate Joint pattern with overall scoring pattern.

- D. Expansion Joints: Provide pre-molded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated.
- E. Locate expansion joints at 30 feet o.c. for each pavement lane unless otherwise indicated.
- F. Extend joint fillers full width and depth of joint, not less than 1/2 inch or more than 1 inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
- G. Provide joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
- H. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.
- I. Fillers and Sealants: All expansion joints shall be completely sealed with Sika Flex. Comply with requirements of applicable Division 7 sections for preparation of joints, materials, installation, and performance.
- J. Refer to Drawings for scoring patterns for:
 - 1. Selected sidewalk areas
 - 2. Service Areas

3.06. CONCRETE FINISHING

- A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
- B. After floating, test surface for trueness with a 10-ft. straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.
- C. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.
- D. After completion of floating and when excess moisture or surface sheen has disappeared, complete troweling and finish surface as follows:
 - 1. Broom finish by drawing a fine-hair broom across concrete surface perpendicular to line of traffic. Repeat operation if required to provide a fine line texture acceptable to Architect.
 - 2. Exposed-Aggregate Finish: At areas indicated on drawings, by applying an approved retardant curing compound to the surface. Allow minimum 12 hours of setting time before washing surface to expose a maximum of (1/3) one-third of stone surface. Aggregate shall be brown Riverstone having a uniform size and color for each subsequent concrete pour. Aggregate size shall range between 1/2" and 3/4".
- E. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Architect.
- F. Construct truncated domes as required at handicap accessibility ramps.

3.07. CURING

- A. Protect and cure finished concrete paving in compliance with applicable requirements of Division 3 sections. Use membrane-forming curing and sealing compound or approved moist-curing methods.

3.08. REPAIRS AND PROTECTIONS

- A. Schedule a review of the curbing prior to the placement of asphalt paving.
- B. Replace cracked, broken or defective concrete curbs and curb and gutter as directed by Architect.
- C. Replace cracked, broken or defective concrete sidewalks as directed by Architect.
- D. Replace cracked, broken or defective concrete pavement as directed by Architect.
- E. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.
- F. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- G. Sweep concrete pavement and clean free of stains, discolorations, dirt, and other foreign material just before final inspection.

3.09. CONCRETE PAVERS

A. Submittals

- 1. Paver color samples for Owner/ Architect selection.
- 2. Five (5) sample pavers of each manufactured type, size, and color specified.
- 3. A 5x5' mock up area shall be constructed for review and approval by the Owner / Architect prior it installing the pavers.

B. Delivery

- 1. Protect unit pavers and aggregate during storage and construction against soiling or contamination from earth and other materials.
- 2. Cover pavers with plastic or use other packaging materials that will prevent rust marks from steel strappin

C. Concrete Pavers

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a) Cambridge Pavers – (Or Approved Equivalent)

- (1) Sherwood – Ledgestone Smooth– 3 Piece Design Kit

- (a) Sizes:

- (i) 9 3/32" x 13 5/8", 9 3/32" x 9 3/32", 4 17/32" x 9 3/32"

- (b) Color:

- (i) TBD

- (c) Finish: ArmorTec Finish

2. Performance Requirements for Concrete Pavers:

Concrete Pavers: Solid, interlocking paving units, ASTM C 936, made from normal-weight aggregates in sizes and shapes indicated.

B. AGGREGATE SETTING-BED MATERIALS

1. Graded Aggregate for Subbase: Comply with VDOT specifications for Size No. 21-A.
2. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements of ASTM C 33 for fine aggregate.
3. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.

3.1 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- D. Joint Pattern: Refer to drawings for layout.
- E. Tolerances: Do not exceed 1/16 inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated, slope, for finished surface of paving.

3.2 SETTING-BED AND PAVER APPLICATIONS

- A. Install concrete base.
- B. Place filter fabric then leveling course screed to a thickness of 1 inch, taking care that moisture content remains constant and density is loose and constant until pavers are set and compacted.
- C. Treat leveling base with soil sterilizer to inhibit growth of grass and weeds.
- D. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.
 1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- E. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:
 1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
 2. Before ending each day's work, fully compact installed concrete pavers to within 36 inches of the laying face. Cover open layers with nonstaining plastic sheets overlapped 48 inches on each side of the laying face to protect it from rain.

- F. Spread masonry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- G. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- H. Repeat joint-filling process 30 days later.

3.3 REPAIR, POINTING, CLEANING, AND PROTECTION

- A. Remove and replace unity pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION 321313

SECTION 321700 - PAVEMENT MARKINGS, SIGNS AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section.
- B. Latest edition of the Arlington County Construction Standards and Specifications Manual and Construction Standards Detail.
- C. Latest edition of the VDOT Road and Bridge Standards and Specifications.

1.2 SUMMARY

- A. This Section includes, but is not limited to, the following:
 - 1. Establishing the location of pavement markings and applying pavement markings for parking space lines, traffic control, fire lane and accessible spaces.
 - 2. Installation of signs for traffic control and accessible spaces.
 - 3. Installation of wheel stops at parking spaces.

1.3 QUALITY ASSURANCE

- A. All work and materials shall conform to the requirements of the latest edition of the Virginia Department of Transportation (VDOT) Road and Bridge Specifications and Road and Bridge Standards.
- B. All materials for signs shall conform to the requirements of the latest edition of the Virginia Department of Transportation (VDOT) Road and Bridge Specifications and Road and Bridge Standards and to the requirements of the latest edition of the Manual of Uniform Traffic Control Devices for traffic signs.
- C. Installer Qualifications: Engage an experienced installer, who has successfully completed striping and signage projects similar in size and complexity to this project. The installer's primary business (defined as a minimum of 60% of total billings) shall be striping and signage.

1.4 SUBMITTALS

- A. Product Data and written confirmation that the following materials are included on VDOT's list of approved construction materials:
 - 1. Pavement marking paint
 - 2. Wheel stops
 - 3. Signs
 - 4. Posts
- B. Installer Qualifications. Must have VDOT Certification for any work within the right-of-way.

PART 2 - PRODUCTS

2.1 PAVEMENT MARKING PAINT

- A. Paint shall be Type A, water emulsion base, traffic paint conforming to the requirements of Section 704 of the VDOT Road and Bridge Specifications and Federal Specification TT-P-1952. Color shall be white unless otherwise indicated.
- B. Curb painting color along fire lanes and cross walks shall be yellow, unless otherwise indicated.
- C. Type B thermoplastic lane markings are required within VDOT rights-of-way.

2.2 PAINT APPLICATOR

- A. Provide hand-operated push-type applicator machine of a type commonly used for application of paint to pavement surfaces. Paint applicator machine shall be acceptable for marking small street and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified.

2.3 WHEEL STOPS

- A. Wheel stops shall be made of 3,000 psi precast concrete and be 6 inches high, 8 inches wide and approximately 6 feet long. Provide chamfered corners and edges and two holes for anchoring.

2.4 SIGNS AND POSTS

- A. Signs shall conform to the requirements of Section 701 of the VDOT Road and Bridge Specifications. Signs shall be fabricated with encapsulated lens sheeting.
- B. Signposts for traffic control signage shall be 4" x 4" treated wood conforming to the requirements of Section 236 of the VDOT Road and Bridge Specifications.
- C. Utilize metal posts for fire-lane signage and for signage at accessible parking spaces.

2.5 CONCRETE

- A. Concrete shall be Class A3, General concrete, conforming to the requirements of Section 217 of the VDOT Road and Bridge Specifications.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION FOR PAVEMENT MARKING

- A. Apply pavement markings only when the ambient temperatures is above 50°F and less than 95°F, unless otherwise approved.
- B. Allow pavement to cure for a period of not less than 7 days before applying pavement marking.
- C. Clean surfaces thoroughly before application of paint. Remove, dust, dirt and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required.
- D. Remove existing pavement markings, residual curing compounds and other coating adhering to the pavement with scrapers, wire brushes, waterblasting, sandblasting or mechanical abrasion as required. Areas of existing pavement affected by oil or grease shall be scrubbed with an approved chemical and rinsed thoroughly. Seal oil soaked areas with shellac or primer after cleaning.

E. Pavement surfaces shall be dry and clean prior to painting. Pavement markings shall not be applied within 24 hours following rain or other inclement weather or when rain is imminent.

F. Apply seal coat across the existing pavement to provide a uniform surface appearance.

3.2 APPLICATION OF PAVEMENT MARKING

A. Apply paint in accordance with the requirements of Section 704 of the VDOT Road and Bridge Specifications.

B. Lay out lines and markings to the width and length as indicated. All parking space lines shall be 4 inches wide.

C. Apply paint with an approved paint applicator.

D. Apply paint at manufacturer recommended rates to provide a minimum 15 mil wet thickness.

3.3 FIRE LANE MARKINGS AND SIGNAGE

A. Mark fire lanes and install fire lane signage in accordance with the requirements of the local Fire Marshall and as indicated on the drawings.

3.4 INSTALLATION OF WHEEL STOPS

A. Secure wheel stops with two 5/8-inch diameter steel reinforcing rods. Rods shall be a minimum of 18 inches in length and be embedded into the pavement, base and subgrade a minimum of 12 inches and be flush with the top of the bumper block.

3.5 INSTALLATION OF SIGNS

A. Install signs on signposts in accordance with the requirements of Section 701 of the VDOT Road and Bridge Specifications.

B. Install signposts in concrete foundation to a depth of 3 feet minimum by 12 inches in diameter.

END OF SECTION 321700

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Posts, rails, and frames.
- B. Wire fabric.
- C. Concrete.
- D. Manual gates with related hardware.
- E. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete anchorage for posts.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- D. ASTM F567 - Standard Practice for Installation of Chain-Link Fence 2014a.
- E. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric 2017.
- F. CLFMI CLF-SFR0111 - Security Fencing Recommendations 2014.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.
- D. Samples: Submit two samples of fence fabric, 12 inch by 12 inch in size illustrating construction and colored finish.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Fence Installer: Company with demonstrated successful experience installing similar projects and products, with not less than five years of documented experience.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Posts, Rails, and Frames:
 - 1. Formed from hot-dipped galvanized steel sheet, ASTM A653/A653M, HSLAS, Grade 50, with G90 (Z275) zinc coating.
 - 2. Line Posts: Type I round.
 - 3. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round.
- B. Wire Fabric:
 - 1. ASTM F668 polymer-coated steel chain link fabric.
- C. Concrete:
 - 1. Type specified in Section 03 30 00.

2.2 COMPONENTS

- A. Line Posts: 1.9 inch diameter.
- B. Corner and Terminal Posts: 2.38 inch diameter.
- C. Gate Posts: 3-1/2 inch diameter.
- D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
- E. Bottom Rail: 1.66 inch diameter, plain end, sleeve coupled.
- F. Gate Frame: 1.66 inch diameter for welded fabrication.
- G. Fabric: 2 inch diamond mesh interwoven wire, 6 gage, 0.1920 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.
- H. Tension Wire: 6 gage, 0.1920 inch thick steel, single strand.

2.3 MANUAL GATES AND RELATED HARDWARE

- A. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

2.4 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
- C. Mounting Plates: As required for mounting fencing to existing concrete slab on grade.

2.5 FINISHES

- A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot.
- B. Components and Fabric: Vinyl coated over coating of 1.8 ounces per square foot galvanizing.
- C. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
- D. Accessories: Same finish as framing.
- E. Color(s): To be selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that areas are clear of obstructions or debris.

3.2 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
 - 1. Mount to slab with base plate where indicated.
- D. Line Post Footing Depth Below Finish Grade: ASTM F567.
- E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F567.
- F. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.
- G. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
- H. Do not stretch fabric until concrete foundation has cured 28 days.
- I. Position bottom of fabric 2 inches above finished grade.
- J. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- K. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- L. Install bottom tension wire stretched taut between terminal posts.
- M. Do not attach the hinged side of gate to building wall; provide gate posts.
- N. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

3.3 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Position: 1 inch.

3.4 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- B. Clean fence with mild household detergent and clean water rinse well.

END OF SECTION

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SECTION 331000 - EXTERIOR WATER SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The provisions of the Contract Documents apply to the work of this Section, except where prohibited by the local water authority.
- B. Service Authority – Arlington County Department of Utilities
 - 1. Latest edition of the Arlington County Construction Standards and Specifications Manual and Construction Standards Detail.
- C. Except where prohibited by the Service Authority and for domestic-only systems, compliance with the National Fire Protection Association 13-2007 and 24-2007 is required.
- D. Reference Specifications are referred to by abbreviation as follows:
 - 1. American National Standards Institute ANSI
 - 2. National Sanitation Foundation NSF
 - 3. American Society for Testing and Materials ASTM
 - 4. American Water Works Association AWWA
 - 5. National Bureau of Standards NBS
 - 6. Virginia Department of Transportation VDOT
 - 7. Virginia Department of Health VDH
 - 8. Service Authority SA
 - 9. National Fire Protection Association NFPA

1.02 SUMMARY

- A. This section includes water service piping, fire protection service mains and appurtenances from the source of water to a point 5 feet outside the building.
- B. Private Water Meter(s) shall be provided onsite at the face of the proposed building. Installation of the water meters shall be part of the Work.

1.03 SUBMITTALS

- A. Submit shop drawings of the following:
 - 1. Pipe
 - 2. Fittings
 - 3. Valves
 - 4. Air Release Valves
 - 5. Valve Boxes and/or Vaults (including frames and covers, ladders, drains, sump pumps and wiring diagrams).
 - 6. Meter Vault Enclosures and Accessories

7. Fire Hydrants
 8. Flushing Hydrants
 9. Fire Department Connections
 10. Backflow Preventers and Assemblies
 11. Yard Hydrants
 12. Thrust Restraint
 13. Detectable Marking Tape
 14. Tracing Wire
- B. Certification provided by the contractor that all water systems and appurtenances have been tested and meet the provisions of the contract documents.
- C. Record Drawings at the completion of the project, indicating the as-built condition of all waterlines, connections and appurtenances.

1.04 QUALITY ASSURANCE

- A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to water systems, and to the requirements of the latest edition of the Virginia Erosion and Sediment Control Handbook for erosion control during installation.
- B. Utility Compliance: Comply with the requirements of Service Authority Standards (latest Addition and Addenda).
- C. Fire Marshall and Building Inspector
- D. Utility installation, bedding, backfill and all connections to be inspected by owners testing agency or local authority having jurisdiction of the utility.
- E. Except where prohibited by the Service Authority and for domestic-only systems, compliance with the National Fire Protection Association 13-2007 and 24-2007 is required.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, and fire hydrants for shipping as follows:
 1. Ensure valves and fire hydrants are dry and internally protected against rust and corrosion.
 2. Protect valves and fire hydrants against damage to threaded ends, flange faces, and coatings.
 3. Set valves and fire hydrants in best position for handling. Set valves and fire hydrants closed to prevent rattling.
- B. Storage: Use the following precautions for valves and fire hydrants during storage:
 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect valves and fire hydrants from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves and fire hydrants off the ground or pavement in watertight enclosures.
- C. Handling: Use a sling to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use hand wheels or stems as lifting or rigging points.

- D. Maintain piping and fittings through shipping, storage, and handling to prevent interior coating and pipe-end damage, and to prevent entrance of dirt, debris, and moisture. If any portion of piping and fittings is damaged, repairs should be made in accordance with manufacturer's recommendations prior to installation.
- E. Protect stored piping and fittings from moisture and dirt. Elevate above grade.
- F. Protect flanges and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.06 PROJECT CONDITIONS

- A. Site Information: Perform site surveys, research public utility records, and verify existing utility locations. Verify that sanitary sewerage system piping may be installed in compliance with original design and referenced standards.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner of others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.
 - 1. Notify Owner and Service Authority not less than 48 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without receiving the Service Authorities and Architect's written permission.
 - 3. Existing utilities across or along the line of work are indicated only in an approximate location. Locate all underground lines and structures. Call "Miss Utility" at 1-800-552-7001 prior to construction. If utilities are marked that are not shown on the plans, locate utility vertically and horizontally and provide information to Architect.
 - 4. Repair and correct any damage to underground lines and structures caused by construction activities.

1.07 SEQUENCING AND SCHEDULING

- A. Coordinate with interior water piping and interior fire protection piping.
- B. Coordinate with other utility work.
 - 1. Utility interruptions shall be coordinated with the Service Authority and the Architect. Written notice 48 hours in advance of utility interruption shall be provided to all affected customers, owner and architect.

PART 2 PRODUCTS

2.01 GENERAL

- A. All piping valves, fittings, fire hydrants, meters, meter vaults, appurtenances and other products, except where prohibited by local water authority.
- B. Except where prohibited by the SA and for domestic only-systems, require ALL pipe, fittings, joints, valves, etc. to comply with NFPA 13 and 24 and be listed for fire service use.-

2.02 PIPE:

- A. Ductile iron pipe shall meet the requirements of AWWA/ANSI C151/A21.51-96. 3" through 12" pipe shall be, at a minimum, pressure class 350; 14" through 20" pipe shall be, at a minimum,

pressure class 250. 24-inch diameter pipe shall be a minimum pressure class 200. Pipe shall have cement-mortar lining and a bituminous seal coat conforming to the requirement of AWWA Standard C104. A minimum of 5% of the pipe furnished shall be gauged for roundness full length and so marked. Pressure class of pipe shall be increased if the specific installation warrants it.

- B. Pipe fittings shall be ductile iron meeting the requirements of AWWA/ANSI C111/A21.11-95, pressure class 250. Fittings shall have a cement-mortar lining and a bituminous seal coating.**
- C. Buried pipe and fittings shall have either mechanical joint or push-on joint, both conforming to the requirements of AWWA C111. Bolts for mechanical joint fittings shall be high strength cast iron having an ultimate tensile strength of 75,000 psi and a minimum yield point of 45,000 psi.
- D. Cell Classification for water pipe shall be 12454-B.
- E. All proposed water pipe shall be buried below the frost line, a minimum of 36" unless otherwise specified on the Contract documents.

2.03 FITTINGS

- A. Fittings shall be ductile iron. Ductile iron fittings shall be in accordance with AWWA C110. Pressure ratings shall be a minimum of 250 psi for fittings 12 inch and smaller and at least 150 psi for fittings 14 inch and larger, or pressure specified for adjacent piping, whichever is greater. All fittings shall be all bell, mechanical joint or mechanical joint plain end unless otherwise approved by the Engineer. All fittings shall have a cement mortar lining on the interior and a bituminous seal coating on the exterior.
 - 1. Mechanical joints at hydrants and line valves shall meet requirements of AWWA C111. Cement mortar lining shall be standard thickness.
 - 2. MEGALUGS, or approved equivalent, shall meet requirements of ANSI/AWWA C153/A21.51.
 - 3. Push-on joint and rubber gasket shall meet requirements of AWWA C111
 - 4. Restrained push-on joints may be used where restrained joints are required.
 - 5. Flanged joints for ductile iron pipe shall meet requirements of ANSI B16.1.
 - 6. Flanged joint gaskets shall be full-face, made of rubber, and shall meet requirements of ANSI B16.21.
 - 7. Cement mortar lining with asphaltic seal coat for ductile iron pipe and fittings or for cast iron fittings shall meet requirements for AWWA C104.
 - a) Cement mortar lining shall be standard thickness.
 - 8. Exterior, asphaltic coating for ductile iron pipe and fittings and cast iron fittings shall meet requirements of AWWA C151 as applicable.
 - 9. Metal harness shall be galvanized rods and clamps as detailed on Contract documents.

2.04 VALVES

- A. Resilient Seat Gate Valves
 - 1. All resilient seat gate valves 6" –12 in size shall comply with AWWA C-509, latest revision.

2. All valves shall be manually operated non-rising stem, equipped with operating nut, for installation in a vertical position, unless otherwise specified, and the valve body shall be ductile iron or high strength cast iron with reinforced flanges.
3. All iron surfaces, internal and external must be coated with a minimum 8 mils thickness of hand applied epoxy or 3-5 mils thickness fusion bonded epoxy.
4. The valve stem shall have an independent stem nut (not rigidly attached to the gate) which allows the gate to flex without stressing the stem.
5. All valves shall have either a bronze stem collar bushing with two O-rings above the stem or a stem collar with one O-ring below and one O-ring above the stem collar.
6. Seating shall use compression closure. The gate shall be of a true bi-directional, mirror image design.
7. Valves shall have a smooth bottom design.
8. Valves shall have a port in the bottom of the gate to allow purging of the gate.
9. All valves shall open left (counter-clockwise). Buried valves shall have mechanical joints while exposed valves shall have flanged joints.
10. The bodies, bonnets and other cast iron parts shall conform in all respects to the American Society for Testing Materials' Standard Specifications of Gray Iron Castings, ASTM Specification Designation A-126, Class B for valve sizes 2" through 12". The castings shall be clean and perfect without blow or sand holes or defects of any kind. No plugging or stopping of holes will be allowed
11. Valves must have a 250 psi working and 400 psi test pressure.
12. If the standard valve provided by a manufacturer does not fully comply with these specifications, but compliance can be attained by providing optional features, then each valve must be permanently marked to indicate the option or options that have been provided. The method of marking valves to indicate that options are included must be approved by the Service Authority.

2.05 VALVE BOXES AND/OR VAULTS

- A. All underground valves, 2" – 16", outside of paved areas shall be installed in approved cast iron valve boxes, having suitable base and shaft sections and covers to protect the valve and permit easy access and operation. Box assemblies shall have screw adjustment. Also provide a 24" x 24" x 4" concrete collar around the valve box (3000 psi. concrete) according to the details on the Contract documents.
- B. Valve boxes shall be two piece with 5.25 inch shaft and read head marked "WATER". Shaft shall be no less than 5 inches in diameter, with a minimum extension range to fit two (2) inch to twelve (12) inch valves inclusive, placed on mains depths of three (3) to five (5) feet of cover in order that the top cover of the valve box is set at finished grade. Valve boxes shall be centered over the valve screw and set plumb.
- C. All valves in which operating nut is greater than three (3) feet below the normal ground or road surface shall be provided with extension stems to bring the operating nut to within two (2) feet of the finished grade. The extension shall be provided with a two inch square operating nut on top and a coupling to connect the extension to the operating nut on the valve. A stem guide shall be provided to keep the valve stem extensions concentric with the valve box. Extension stems shall be of the same diameter as the valve stem unless otherwise specified.

2.06 FIRE HYDRANT

- A. Fire hydrants shall be manufactured in full compliance with this specification and shall also comply with the AWWA Fire Hydrant Specification C-502, latest revision and the following:
1. Type: Compression - Dry Standpipe: Valve shall open against and close with the pressure. The design shall be such that all internal operating parts can be removed through the standpipe and main valve rod extended without excavating. Hydrants shall be one of three specified by the Service Authority and shall be a traffic model type.
 2. Size: Internal valve diameter shall be a minimum 5”.
 3. Inlet Size and Type: 6” mechanical joint end with accessories.
 4. Hose Nozzles: Each hydrant shall be equipped with two 2-1/2” I.D. hose nozzles with National Standard threads, one quarter turn bayonet lock or threaded in with O-ring seal and suitable locking arrangement.
 5. Steamer Nozzle: Each hydrant shall be equipped with one 4-1/2” Steamer Nozzle having National Standard Threads, one quarter turn bayonet lock, or threaded in with O-ring seal and suitable locking arrangement.
 6. Direction of Open: Left, counterclockwise.
 7. Size and Shape of Operating Nut and Cap Nuts: to be 1-1/2” point to flat pentagon. Each hydrant shall be equipped with a weather cap. Nozzle caps shall be provided for all outlets with suitable gaskets to provide a tight seal with the nozzles. Said caps shall be securely chained to the barrel of the hydrant.
 8. Seal Plate: The hydrant shall be so constructed that a moisture-proof lubricant chamber is provided which encloses the operating threads, thereby automatically lubricating the threads each time the hydrant is operated. The lubricant chamber shall be enclosed with at least three O-rings. The two lower O-rings will serve as pressure seals; the third O-ring will serve as a combined dirt and moisture seal to prevent foreign matter from entering the lubricant chamber. The hydrant shall be equipped with either an anti-friction washer or bronze bushing to reduce operating torque. The bonnet will be secured to the hydrant using bolts and nuts.
 9. Standpipe - Groundline Safety Construction: The standpipe sections shall be connected at the groundline by a two part, bolted safety flange or breakable lugs. The main valve rod sections shall be connected at the groundline by a frangible coupling. The standpipe and groundline safety construction shall be such that the hydrant nozzles can be rotated to any desired position without disassembling and removing the top operating components and the top section of the standpipe. The minimum inside diameter of the standpipe shall be 6”.
 10. Main Valve, Rod Assembly: The main valve rod assembly shall be so constructed to allow removal of all operating parts through the standpipe regardless of depth of bury, using a removal wrench which does not extend below the groundline of the hydrant. The main valve seat ring shall be bronze, and its assembly into the hydrant shall involve bronze to bronze thread engagement, and the valve assembly pressure seals shall be obtained without the employment of torque compressed gaskets. The design of the main valve rod shall be such that operating threads at the top of the rod and the valve assembly threads at the bottom of the rod are isolated from contact with water in the standpipe or in the hydrant inlet shoe.
 11. Drain Valve: The operation of the drain mechanism shall be correlated with the operation of the main valve and shall involve a momentary flushing of the drain ports each time the hydrant is opened. The drain ports shall be fully closed when the hydrant valve is more than 2-1/2 turns

open and the drainage channel in the bronze valve seat ring shall connect to two or more outlet drain ports. No springs may be employed in the hydrant valve or drain valve mechanism.

12. Depth of Bury: Normally hydrants shall be suitable for installation in trenches 4-1/2' deep. Required parts and materials to adjust fire hydrants to different depth of bury shall be provided by the manufacturer to meet actual field conditions as required.
13. Painting Instruction: All fire hydrants shall be painted with at least two (2) coats of fire hydrant paint pursuant to Prince William County Sanitation Authority from the bonnet down. The bonnet shall be painted with 1460 alert bright white light reflective coating (or per SA), manufactured by Axon Aerospace, Inc. The wetted surface of the hydrant shoe shall be epoxy coated to prevent corrosion of the waterway.
14. Pressure Rating: Test pressure 300 psi, working pressure 150 psi.

B. Approved Manufacturers include:

1. Mueller Centurion A-421
2. Kennedy 4-1/4" Figure K-81A
3. U.S. Pipe - Metropolitan 250
4. American Flow Control - Mark 73

- C. If the standard hydrant provided by a manufacturer does not fully comply with these specifications, but compliance can be attained by providing optional features, then each hydrant must be permanently marked to indicate the option or options that have been provided. The method of marking hydrants to indicate that options are included must be approved by the Engineer.

2.07 FLUSHING HYDRANTS

- A. Flushing hydrants shall be manufactured in full compliance with the following specifications and shall also comply with AWWA's latest specifications on flushing hydrants:

1. The flushing hydrant shall be capable of being locked and shall be freeze-proof. It shall be equipped with National Standard fire thread connections and a breakaway union for high traffic areas.
2. It shall be of size 2".
3. The hydrant barrel shall be 2" iron pipe. The exterior shall be painted with approved coating for durability. The overall length of hydrants can vary according to the depth of water systems.
4. The barrel and the standpipe shall be joined with a breakable malleable union. A brass hose connection, 2-1/2" NSFT with attached cap and chain, shall be provided for convenience in flushing.
5. The body valve shall have bronze body with automatic weep, such that when the valve is in OFF position the hydrant barrel shall automatically drain. The valve stem shall be above ground and shall be lockable to prevent tampering. Its operating device shall be of key-type design, with permanent attachment to the valve stem.

- B. Approved manufacturers and model numbers:

1. Kupferle Foundry number 78 (with straight neck).

2.08 THRUST RESTRAINT

- A. Thrust blocking and/or joint restraint units shall be as specified on Contract documents or as directed by the inspector based upon field conditions. Concrete shall have 3000 psi strength at 28 days, and shall meet requirements of ASTM C94. Except where prohibited by local water authority.
- B. Except where prohibited by the SA and for domestic-only systems, thrust restraint to comply with NFPA 13-2007 and NFPA 24-2007.

2.09 DETECTABLE MARKING TAPE

- A. Tape shall be polyethylene tape with a metallic core, 2" in width, with the continuous printed message, "Caution – Waterline Buried Below."
- B. Tape shall be Catalog No. 2 WAT as manufactured by the Seton Name Plate Corp. or approved equal.
- C. Tape shall be installed 18" above the utility line during backfill operations.

PART 3 EXECUTION

3.01 PIPE LAYING

- A. Take all precautions necessary to insure that pipe, valves, fittings, and other accessories are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material. Except where prohibited by local water authority.
- B. Except where prohibited by the SA and for domestic-only systems, ALL pipe, fittings, joints, valves, etc. to be installed in compliance with NFPA 13 and 24, the device listings, the manufacturer's installation instructions.
- C. Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. Close ends of in-place pipe at the end of any work period to preclude the entry of animals and foreign material. Bedding of pipe shall be as specified on the Contract documents.
- D. Do not lay pipe when trench bottom is muddy or frozen, or has standing water.
- E. Use only those tools specifically intended for cutting the size and material and type pipe involved. Make cut to prevent damage to pipe or lining and to leave a smooth end at right angles to the axis of the pipe.
- F. Lay pipe with bell ends facing the direction of laying. Where grade is 10 percent or greater, lay pipe uphill with bell ends upgrade.
- G. Separation of sanitary sewer lines and water lines shall be in accordance with the Service Authority Regulations.

3.02 JOINING MECHANICAL JOINT PIPE

- A. Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating and other foreign matter. Paint the bell and the spigot with soap solution (half cup granulated soap dissolved in 1 gallon water). Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.

- B. Push the spigot end forward to seat in the bell. Then, press the gasket into the bell so that it is located evenly around the joint. Move the gland into position, insert bolts and screw nuts up finger tight. Then tighten all nuts to torque listed below

Bolt Size - Inches	Torque Ft. - Lbs.
5/8	40 – 60
3/4	60 – 90
1	70 – 100
1-1/4	90 – 120

Tighten nuts on alternate side of the gland until pressure on the gland is equally distributed. Join lock-type mechanical joint pipe according to manufacturer's recommendations.

- C. Permissible deflection in mechanical joint pipe shall not be greater than 1/2 of that listed in AWWA C600.
- D. Permissible deflection in lock-type mechanical joint pipe shall be as recommended by manufacturer.

3.03 JOINING PUSH-ON JOINT PIPE

- A. Thoroughly clean inside of the bell and 8 inches of the outside of spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant supplied by pipe manufacturer, to either the gasket or the spigot end of the joining pipe. Start the spigot end of the pipe into the socket with care. Then complete the joint by forcing the plain end of the bottom of the socket with a forked tool or jack-type device. File the end of field cut pipe to match the manufactured spigot end.
- B. Join restrained push-on joints according to manufacturer's recommendations.
- C. Permissible deflection in restrained push-on joint pipe shall be not greater than 1/2 of that recommended by manufacturer.
- D. Join PVC pipe and fittings in accordance with manufacturers' instructions and install in accordance with ASTM D2321.

3.04 SETTING VALVES AND VALVE BOXES

- A. Install valves with operator stems in the vertical plane through the pipe axis and perpendicular to the pipe axis. Locate valves where specified on Contract documents. Thoroughly clean before installation. Check valves for satisfactory operation.
- B. Equip all underground valves with valve boxes where specified on the Contract documents. Set valve boxes in accordance with the Contract documents. Set box in alignment with valve stem centered on valve nut. Set the valve box to prevent transmitting shock or stress to the valve. Set the box cover flush with the finished ground surface or pavement. PVC extensions shall not be permitted.

3.05 JOINT RESTRAINTS

- A. Provide reaction anchors of concrete blocking, metal harness, retainer gland type or restrained joint type pipe at all changes in direction of pressure pipelines and as specified on Contract documents.
- B. Concrete reaction anchors shall bear against undisturbed earth and shall be of the size and shape specified on the Contract documents.
- C. Use metal harness restraints as specified on Contract documents.
- D. Where retainer glands are used, extreme care shall be taken so that each set screw is tightened as recommended by the manufacturer before the pipe is backfilled and tested.

3.06 DETECTABLE WARNING TAPE

- A. Install detectable warning tape in utility trench above all pipes in accordance with manufacturer's recommendation. Install tape approximately 12 to 18 inches above the pipe, not less than 24 inches nor more than 54 inches deep along the side of the trench in such a manner as not to be broken or otherwise damaged during backfilling or compacting.
- B. Electric tracing wire must be completely insulated from ground. The wire will be attached to the top of water main by non-conductive method such as Duct Tape.

PART 4 TESTING

4.01 PRESSURE AND LEAKAGE TESTS

- A. The Contractor is responsible for supplying water required for testing, except where prohibited by local water authority.
- B. Except where prohibited by the SA and for domestic-only systems, the hydrostatic testing, including (but not limited to) the leakage limits and the minimum 200 psi test pressure, to comply with NFPA 13 and 24.
- C. Except where prohibited by the SA and for domestic-only systems, after the line has been backfilled and at least seven days after the last concrete reaction anchor has been poured, subject the line or any valved section of the line to a hydrostatic pressure test in accordance with AWWA C600, except as modified herein, to comply with NFPA 13 and 24. Fill the system with water at a velocity of approximately 1 ft. per sec. while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 1.5 x the working pressure. Test pressure shall: (1) Not be less than 1.25 x the working pressure at the highest point along the test section; (2) Not exceed thrust restraint pressure; (3) Not vary by more than + or - 5 psi; (4) Not exceed twice the rated pressure of the valves or hydrants when test includes closed gate valves; (5) Not exceed rated pressure of valves if resilient-seated gate valves or butterfly valves are used; (6) Shall be at least 100 psi. Measure pressure at the low point on the system compensation for gage elevation. Maintain this pressure for two hours. If pressure cannot be maintained, determine cause, repair and repeat the test until successful.
- D. A leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quality of water to maintain a pressure within 5 psi of the specified test pressure, after air has been expelled and the pipe filled with water. Leakage shall not exceed that specified by AWWA C-600. If leakage exceeds that specified, find and repair the leaks and repeat the test until successful.

- E. All visible leaks shall be repaired regardless of the amount of leakage in a manner approved by the Service Authority.

4.02 DISINFECTION

- A. Disinfect, flush and test water mains and accessories in accordance with the procedures listed below. The water used in the disinfection process shall be potable water from an approved supply. If water is to be transported to the subject site, then the tank trucks must also be properly disinfected prior to transporting water. Disinfection of the vehicle should also include all appurtenances used such as valves, hoses, etc. except where prohibited by local water authority.
- B. Except where prohibited by the SA and for domestic-only systems, the underground systems to be flushed in compliance with NFPA 13 and 24.
- C. Preliminary Flushing: The main shall be flushed prior to disinfection, except when the tablet method is used. Flushing shall be at a velocity of not less than 3.0 ft/sec. Adequate provisions shall be made for drainage of flushing water. Flushing is to be performed only with the approval of and under the direction of the County Inspector. The contractor shall inspect areas of discharge and provide the necessary equipment to prevent any environmental damage or erosion. The Contractor shall be responsible for any damage that may result from flushing.
- D. Form of Chlorine for Disinfection:
 - 1. Liquid chlorine shall be used only when suitable equipment is available and only under the direct supervision of a person familiar with the physiological, chemical, and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise. Introduction of chlorine-gas directly from the supply cylinder is unsafe and shall not be permitted
 - 2. Calcium hypochlorite contains 70 percent available chlorine by weight. It shall be either granular or tabular form. The tablets, 6-8 to the ounce, are designed to dissolve slowly in water. A chlorine-water solution shall be prepared by dissolving the granules in water in the proportion requisite for the desired concentration.
 - 3. Sodium hypochlorite is supplied in strengths from 5.25 to 16 percent available chlorine. The chlorine-water solution shall be prepared by adding hypochlorite to water. Product deterioration shall be reckoned with in computing the quantity of sodium hypochlorite required for the desired concentration.
 - 4. Application: The hypochlorite solutions shall be applied to the water main with a gasoline or electrically-powered chemical feed pump designed for feeding chlorine solutions. For small applications the solutions may be fed with a hand pump, for example, a hydraulic test pump. Feed lines shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.
- E. Methods of Chlorine Application:
 - 1. Continuous Feed Method: Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 MG/L available chlorine. To assure that this concentration is maintained, the chlorine residual shall be measured at intervals not exceeding 2,000 feet in accordance with the procedures described in the current edition of "Standard Methods" and

AWWA M12 - “simplified procedures for water examination”. In the absence of a meter, the rate may be determined either by placing a pitot gage at the discharge or by measuring the time to fill a container of known volume. Table I gives the time to fill a container of known volume. Table I gives the amount of chlorine required for each 100 ft. of pipe of various diameters. Solutions of 1 percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately 1 lb. of calcium hypochlorite in 8.5 gallon of water.

TABLE I

CHLORINE REQUIRED TO PRODUCE 50 MG/L CONCENTRATION
IN 100 FT. OF PIPE - BY DIAMETER

100 Percent	1 Percent	
Pipe Size	Chlorine	Chlorine Solutions
<u>In.</u>	<u>Lb.</u>	<u>Gal.</u>
4	0.027	0.33
6	0.061	0.73
8	0.109	1.30
10	0.170	2.04
12	0.240	2.88
16	0.430	5.12
20	0.675	8.00

During the application of Chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24 hour period, the treated water shall contain no less than 25 MG/L chlorine throughout the length of the main.

2. Slug Method (use only if authorized by Engineer): Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate into the newly laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at no less than 300 MG/L. The chlorine shall be applied continuously and for a sufficient period to develop a solid column or “slug” of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 300 MG/L for at least 3 hours. The application shall be checked at a tap near the upstream end on the line by chlorine residual measurements.

As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated so as to disinfect appurtenances.

3. Tablet Method: Use only when scrupulous cleanliness has been exercised because preliminary flushing cannot be used. Do not use this method if trench water or foreign material has entered the main or if the water is below 41 deg. f (5 deg. C). This method may be used for mains up to 12 inches in diameter and where the total length of the main is less

than 2,500 feet. Tablets shall not be used with PVC pipe.

Place tablets in each section of pipe and also in hydrants, hydrant branches, and other appurtenances. Attach tablets using Permatex No. 1 adhesive or other adhesive approved by the engineers, except for the tablets placed in hydrants and in the joints between the pipe sections. Tablets shall be free of adhesive except on the one broad side to be attached. Place all tablets at the top of the main. If the tablets are attached before the pipe section is placed in the trench, mark the position of the tablet in the pipe and assure that the pipe is placed with the tablet at the top.

The following table shows the number of 5 grain HTH tablets necessary per joint of pipe to obtain 50 PPM chlorine.

<u>PIPE SIZE</u>	<u>TABLETS PER 18-20 FT. JOINT</u>
3 IN.	1
4 IN.	1
6 IN.	2
8 IN.	3
10 IN.	4
12 IN.	7

When installation is completed fill the main with water at a velocity of less than 1 foot per second. The water shall remain in the pipe for at least 24 hours. Operate valves so that the strong chlorine solution will not flow back into the line supplying the water.

- F. Final flushing: After the applicable retention period the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 MG/L. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline.
- G. Bacteriologic Tests:
1. After final flushing, and before the water main is placed in service, samples shall be collected and tested for bacteriologic quality and shall show the absence of coliform organisms. At least two samples shall be collected at least 24 hours apart at intervals not exceeding 2,000 ft. and tested by a State Health Department approved laboratory and results submitted to engineer.
 2. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory and disinfection shall be repeated until the samples are satisfactory. Cleaning, disinfection and testing will be the responsibility of the contractor. Water for these operations will be furnished by the owner, but the contractor shall include in his bid the cost of loading, hauling and discharging the water.
 3. A sampling tap consisting of a corporation cock with metal pipe shall be installed within two feet of valves. The corporation stop inlet shall be male one inch in size and the outlet shall have one inch I.P. threads and a cap.
- H. Testing and disinfection of the completed sections shall not relieve the Contractor of his responsibility to repair or replace any cracked or defective pipe. All work necessary to secure a tight line shall be done at the Contractor's expense.

END OF SECTION 331000