

**SPECIFICATIONS  
FOR  
INTERNATIONAL ARRIVALS BUILDING  
MODIFICATIONS – PHASE IV LITE  
IT1109**

**WASHINGTON DULLES INTERNATIONAL AIRPORT  
METROPOLITAN WASHINGTON AIRPORTS AUTHORITY**

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**100% SUBMITTAL**



# **PROCUREMENT AND CONTRACTING REQUIREMENTS**

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### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. The articles and paragraphs of this Section represent supplements or additions to the Contract Provisions or the Special Provisions.

#### 1.3 WORK UNDER OTHER CONTRACTS

- A. During the period of this Project, the Authority anticipates that other construction contracts may be underway at or near the site of work of this Contract.

#### 1.4 PERMITTING

- A. RESERVED
- B. Comply with all requirements set forth in the Authority's "Building Codes Manual". This manual describes Building Codes organization, Construction permitting process, Building Code inspection process, Certificate of Occupancy requirements, and information regarding elevators, escalators, and moving walks.

#### 1.5 MAINTENANCE OF PEDESTRIAN AND VEHICULAR TRAFFIC

- A. Maintain adequate pedestrian and vehicular traffic flow and safety along the service roads, sidewalks, parking lots and other roadways on Airport property. In addition, this requirement applies to crossroads, approaches, and entrances affected by or made necessary by the Work. Coordinate activities throughout the project in a manner that allows emergency access, without delays to emergency response vehicles, to all areas of the Project that are occupied by employees.
- B. RESERVED
- C. Prior to starting construction operations affecting pedestrian, vehicular, or aircraft traffic movement, submit and obtain the COTR's written approval of a Traffic Maintenance Plan. Develop plan in accordance with the safety requirements of the FAA, Airport Operations, and the Commonwealth of Virginia Department of Transportation's "*Manual of Uniform Traffic Control Devices*". Utilize the form indicated in the latest edition of the Virginia Department of Transportation's "*Virginia Work Area Protection Manual – Standards and Guidelines*".

- D. Provide and maintain temporary signage, "Jersey barriers," and such other traffic control devices or personnel as required complying with approved Traffic Maintenance Plan.
- E. Maintain the construction operations affecting pedestrian, vehicular, or aircraft traffic movement from the beginning of construction operations until final acceptance of the project. The maintenance shall constitute continuous and effective work prosecuted day by day with adequate equipment and forces to the end of project to ensure that roadways and structures are maintained in satisfactory condition at all times, including barricades and warning signs as necessary for performance of the work.
- F. Keep the portions of the project being used by public, pedestrian, aircraft, [mobile lounges] and vehicular traffic, whether it is through or local traffic, in such condition that traffic will be adequately accommodated. Remove snow and control all ice within the project boundaries. Removal of snow and ice for the benefit of the traveling public will be performed by the Authority. Bear all cost of maintenance work during construction and before the project receives a Certificate of Occupancy for constructing and maintaining approaches, crossings, intersections and other features as may be necessary.
- G. Keep the portions of the road and aircraft pavement surfaces being used by the public free from irregularities, obstructions, mud, dirt, snow, ice, and any characteristic that might present a hazard or annoyance to traffic in such condition that traffic will be adequately accommodated. Maintain a vacuum/sweeper and flusher truck at the site at all times to clean roadway and aircraft surfaces affected by construction traffic at the request of Airport Operations or the COTR.

#### 1.6 AIRFIELD AND TERMINAL BUILDING OPERATIONAL REQUIREMENTS

- A. RESERVED
- B. The Work, or a portion thereof, will be performed within the public Terminal or Concourse buildings. Normal airport operations and public activities will continue adjacent to the Work during all phases of the Project. These include:
  - 1. Passenger enplaning and deplaning.
  - 2. Passenger baggage deposit/retrieval.
  - 3. Passenger ticketing operations.
  - 4. Food/Concession services.
  - 5. Ground transportation arrivals/departures.
  - 6. Maintenance, custodial and support activities.
- C. Phase construction activities as necessary to accommodate all airport operations without disruption. Adhere to all current Airport Orders and Instructions (O & Is), Airport Bulletins, and Airport Advisories. The Authority will provide relevant Orders and Instructions to Offerors in the Solicitation Package. Bulletins and Advisories will be provided to the offeror by the Authority as they are issued.



#### 1.7 ENVIRONMENTAL PROTECTION

- A. Comply with all Federal, state and local laws and regulations controlling pollution of the environment. Take necessary precautions to prevent pollution of streams, rivers, lakes, ponds, and reservoirs with fuels, oils, bitumens, chemicals, or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter.
- B. Notify COTR immediately in the event that abnormalities, discolorations, odors, oil, or other signs of potential contamination by hazardous materials are encountered during excavation or other construction activities. Follow with written notice within 24 hours, indicating date, time, and location of potential contaminants encountered. The COTR will provide further direction to Contractor regarding disposition of materials encountered.
- C. All painted surfaces are assumed to contain lead-based paint. The Contractor shall maintain the necessary health and safety requirements for all personnel in accordance with OSHA regulations to work in these conditions. The removal and disposal of lead-based paint is part of this contract.

#### 1.8 ARCHAEOLOGICAL AND HISTORICAL FINDINGS

- A. Notify immediately, through the COTR, the PMC Archaeology/Historic Preservation Coordinator if subsurface structural features, concentrations of artifacts, rubble, bone/shell, or burnt material are uncovered or otherwise discovered. Prompt reporting will avoid potentially severe problems resulting from the destruction of significant resources and may limit the impact on construction operations and schedules.

#### 1.9 DAMAGES AND PRE-EXISTING CONDITIONS

- A. Be responsible for all damages caused by Contractor's construction activities. Provide all labor, materials, etc. to return any damaged areas, systems or equipment to their original condition at no additional cost to the Authority.
- B. Perform a survey of pre-existing conditions in the vicinity of Contractor's construction activities, utilizing photographs and other means as necessary to document existing damage or conditions. Submit two copies of this survey to the Contracting Officer within 21 calendar days after Notice-to-Proceed. This survey will assist in resolving any damage claims against the Contractor during and after construction.
- C. Preserve all roadways, pedestrian and directional signage. Deliver all signs removed and not required for reinstallation to the Authority as directed by the COTR.
- D. Replace or repair lost or damaged signs at no cost to the Authority.

#### 1.10 SECURITY DURING CONSTRUCTION

- A. Maintain the integrity of the Airport Security fence. Maintain the integrity of doors and walls between public areas and Air Operations Area (AOA) at all times. Comply with Title 49 Code of Federal Regulations, Parts 1500, 1540, 1542 and 1544.

- B. Pay all fines levied by the Transportation Security Administration for penalties resulting from security infractions perpetrated by or caused by Contractor's personnel or work forces of Contractor's subcontractors or suppliers.
- C. Establish and maintain the security of Contractor's staging areas, equipment and materials.
- D. Provide escort for delivery vehicles transporting materials and supplies to or from the Contractor's staging or work areas into the AOA, in accordance with requirements stated in "Airport Orders and Instructions" attached as part of the Contract.
- E. Do not park within 300 feet of a terminal building unless specifically authorized by Airport Operations.
- F. All workers in the sterile areas, which are defined as areas accessible to ticketed passengers only, may utilize tools in their work provided that:
  - 1. Tools are essential and necessary to the Work.
  - 2. Keep tools controlled at all times.
  - 3. Do not leave tools unattended.
  - 4. Store tools in locked boxes.
- G. No knives will be permitted in the sterile areas.
- H. When Work involves need for access to restricted areas under jurisdiction of U.S. Customs & Border Protection (CBP), secure necessary special security clearances to operate in the International Arrivals Building areas as prescribed by the U.S. Customs & Border Protection. Each company working in the CBP area shall apply for and obtain a bond from the CBP. Check with CBP on requirements to obtain security clearances.
- I. No firearms or weapons of any type are allowed on the airport.
- J. No cartridge style nail guns, nor any tools that use a cartridge or any explosive charge, are allowed without prior written notification of COTR. Obtain written approval from the COTR before bringing such tools on the project.
- K. Conform to all Orders and Instructions pertaining to vehicle inspection.
- L. Notify the COTR at least 72 hours in advance of his requirement for scheduled taxiway, taxi lane or roadway closures. Obtain the written approval of the Authority prior to closing or crossing a taxiway, taxi lane or roadway.
- M. Bear all costs associated with establishing, maintaining, signing, lighting and marking haul routes and taxiway crossings. These costs are considered incidental to the pay items of this Contract.
- N. Use load covers on all dump trucks. Load dump trucks so that no spillage occurs during transit on the State, municipal, or Airport roadways, taxiways, and aprons. Clean wheels of trucks leaving the Project construction site of all soil and rocks.

#### 1.11 AUTHORITY CONSULTANT

- A. The Contractor is hereby advised of the involvement of an Authority Consultant (Consultant) as Construction Phase Support Services Consultant to the Authority. Consultant will have a continuing role in this project by assisting the Authority in specialized areas.

Consultant will provide administrative support during solicitation, and construction.

1. Consultant will coordinate Contractor requests for technical information and receive, review and manage all Contractor submittals.
  2. Consultant will be responsible for review of technical submittals during construction, including selected shop drawings, certifications, test reports, calculations and samples.
  3. Consultant will conduct field inspections of the Work in progress and inspect for Substantial Completion and Final Acceptance. Consultant inspection does not relieve Contractor of responsibilities of performing Contract required inspections as required by contract documents.
- B. All other contract management is the sole responsibility of the Authority.

#### 1.12 SAFETY

- A. Comply with all requirements set forth in the most current edition of the Authority *Construction Safety Manual*". Offerors are provided with the most recent addition when obtaining contract documents prior to proposal. Requirements included in this Section are in addition to the Authority's *Construction Safety Manual*. Comply with all local, State and Federal requirements. Where conflicts or discrepancies exist between requirements, the more stringent requirement shall govern. For additional information see Division 01 Section "Quality Requirements".

- B. Contractor Safety Organization:

1. Safety officer.

- a. Duties: Outlined in The Authority *Construction Safety Manual*.
- b. Qualifications: Outlined in The Authority *Construction Safety Manual*.

- C. Submit the résumés of individuals proposed to serve in the role of Contractor's Safety Officer to the COTR for approval in writing. In addition to indicating the qualifications in the Authority *Construction Safety Manual* résumés shall include but not be limited to such items as: work experience, education, safety and health training completed, memberships in professional associations, professional certifications, professional registrations and professional references confirming the qualifications and personal references of contacts for verification shall also be required.

- D. Provide safe and healthful working conditions on each operation at all times during execution the work of this Contract. Conduct the various operations connected with the Work so that they will not be injurious to safety or health. Comply with all provisions, regulations and recommendations issued pursuant to the Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, as well as amendments to these laws. Comply with laws, rules and regulations of other authorities having jurisdiction, with regard to all matters relating

to the safety and health of workers and the general public. Compliance with government requirements is mandated by law and considered only a minimum level of safety performance. Perform all work in accordance with best safe work practices recognized by the construction industry. Stop work whenever a work procedure or a condition at a work site is deemed unsafe by the either of the following individuals: COTR, Program Safety Manager (PSM), the Contractor's Project Manager, the Contractor's Foreman, or the Contractor's Safety Officer.

- E. Comply with all requirements set forth in the Authority's "Construction Safety Manual." Provide during the Work the services of Safety Manager(s)/Safety Engineer(s) as outlined in the Authority's "Construction Safety Manual" and in Division 01 Section "Quality Requirements". The Safety Engineer shall undertake the duties and responsibilities as stated in the Authority's "Construction Safety Manual".
- F. Fire Safety: Conform to the following requirements:
  - 1. Obtain a permit to perform any welding, cutting, or hot work from the Office of the Authority Fire Marshal.
  - 2. Ensure adequate access to all construction areas for emergency response.
  - 3. Obtain a permit from the Office of the Authority Fire Marshal to store, handle, or use any hazardous material, including but not limited to fuels for equipment. Complete an application prior to issuance.
  - 4. Remove combustible debris from the site daily.
  - 5. Provide at least seven (7) days notice for any request for inspections, tests, permits, etc., required of personnel from the Office of the Authority Fire Marshal.
  - 6. Provide to the Office of the Authority Fire Marshal a list of emergency contact numbers for the COTR and the Contractor prior to the commencement of Work.
- G. Submit Site-Specific Safety and Health Plans or narrative to COTR within 15 calendar days of Notice to Proceed and prior to the start of any construction activities. Prepare this plan using the Authority's Guidelines as defined in the Authority's "*Construction Safety Manual*" and as supplemented by these specifications for each and every work zone as shown on the drawings or as anticipated by the Contractor. COTR must approve the Site-Specific Safety Plan or waiver prior to the start of any work.
- H. Be responsible for the safe operation of all job site motor vehicles. Provide a "spotter" or flagman for all backing operations of construction vehicles with restricted rear vision.
- I. All motorized equipment and vehicles working on or entering MWAA construction project work areas shall be equipped with functional audible backup alarms.
- J. Crane Operators. On Airports Authority projects, Crane Operators shall be certified to operate the equipment by an approved independent certifying agency.

#### 1.13 NOISE CONTROL

- A. The Authority recognizes and can tolerate a normal level of noise created by a majority of construction activity. However, in the interest of the Authority's neighbors, the maximum

acceptable noise level between the hours of 5:00 pm and 7:00 am the following morning is limited to 55 decibels. During daytime hours of 7:00 am through 5:00 pm, the maximum acceptable noise level for sustained or repetitive noises is 72 decibels. Measure the noise level using an "A" scale at a point 4'-0" above ground at property line nearest noise source.

- B. Secure advance written approval from the COTR prior to scheduling any activity that is anticipated to produce a sustained or repetitive noise level higher than the decibel limits indicated above.
- C. In and around terminal facilities and buildings whose normal occupancy is from 7 a.m. to 7 p.m., perform work that causes noise that is disruptive to the airport's tenants or the traveling public between the hours of 11:00 pm and 5:00 am. Measure noise for this situation using an "A" scale at a point 4'-0" above ground at the closest point to airport tenants or the traveling public.

#### 1.14 EXAMINATION OF PLANS, SPECIFICATIONS AND SITE OF WORK

- A. The offeror is expected to examine carefully the site of the proposed work, the proposal, plans, specifications, solicitation provisions, contract provisions, special provisions and contract forms before submitting a proposal. The submission of a proposal will be considered conclusive evidence that the offeror has made such examination and is satisfied as to the conditions to be encountered in performing the work as to the requirements of the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 007300

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## **GENERAL REQUIREMENTS**

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## SECTION 011000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
1. Work covered by the Contract Documents.
  2. Type of the Contract.
  3. Work phases.
  4. Work under other contracts.
  5. Products ordered in advance.
  6. Authority-furnished products.
  7. Use of premises.
  8. The Authority's occupancy requirements.
  9. Work restrictions.
  10. Specification formats and conventions.

#### 1.3 WORK COVERED BY CONTRACT DOCUMENTS

Project Identification: An expansion of the IAB is currently underway. Phase IV Lite includes interior improvements to the secondary customs inspection and existing portions of the arrival hall to improve passenger flow and create a unified architectural space (with the expansion of the IAB currently underway)

Work areas include:

- Customs and Border Protection (CBP) secondary inspection area and the adjacent corridor
- Baggage recheck area.
- International arrivals meeter/greeter area.

Specific work items are shown on the attached exhibit and include:

- Removal of the partition wall in the meeter/greeter area
- Removal and relocation of Information kiosk to the current exit area
- Remove and dispose of the FID in the meeter/greeter area

- Remove the wall and incorporate Storage Area (G-514A) into the recheck area
- Reconfigure the exit doors in the recheck area
- Incorporate the existing CBP Conference and Break Rooms into the recheck area
- Remove ticket counters in the recheck area and reinstall on the southside
- Remove the north wall in the recheck area and the wall between corridor (G-510A) and bag cart return (G-510B)
- Install a new wall in the recheck area 3-feet north of the existing wall
- North/west/south/East walls in the recheck area to receive new treatment (will match the new IAB finishes)
- Remove the existing glass wall in the CBP secondary inspection area and reinstall new glass wall with materials matching those in the expanded IAB
- New terrazzo floor, ceiling tiles and lighting for the corridor (G-009) matching new IAB materials
- The storefront along the north side of the corridor may receive minor treatments
- Mechanical, Electrical, Plumbing, Fire Protection and special systems (security) work to accommodate modifications.

Work includes but not limited to demolition and removal of existing walls, doors, flooring, and installation new partition walls, doors, flooring along with associated mechanical, electrical, fire protection and security systems.

1. Project Location: Washington Dulles International Airport
- B. Architect/Engineer Identification: The Contract Documents, dated June 15, 2011, were prepared by Airport Design Consultants, Inc.
- C. The Work consists of the following items:
  1. The Work includes miscellaneous components of building work.
  2. For additional requirements for the examination of plans, specifications, and Project site see Section "Supplementary Conditions."

#### 1.4 TYPE OF CONTRACT

- A. Project will be constructed under a general construction contract.

#### 1.5 WORK PHASES

- A. As shown on the drawings.

- B. Work phasing indicated in the drawings is not intended to restrict Contractor to this specific phasing. Contractor may submit its own phasing schedule to COTR for review and written approval.
- C. Schedule the execution of the Work according to the phasing sequence indicated and to avoid interference with normal functions of the Airport.
- D. Before commencing Work of each phase, submit a schedule to COTR showing the sequence, the commencement and completion dates, and the move-out and move-in dates of personnel for the various phases of the Work.
- E. On completion, each phase of the Work shall be fully operational.

#### 1.6 WORK UNDER OTHER CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Preceding Work: Authority has awarded separate contract(s) for construction operations associated with the International Arrivals Building at the Project site. Work under those contracts may be completed concurrent with work under this Contract.

#### 1.7 USE OF PREMISES

- A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
  - 1. Limits: Confine constructions operations to the areas shown on the contract documents.
  - 2. Authority Occupancy: Allow for Authority occupancy of site and day-to-day use by tenants, air carriers, and the public.
  - 3. Contractor shall have full use of premises for construction operations within the Contract Limit Lines indicated during construction period, during the hours indicated, and as directed by COTR. Contractor's use of premises is limited only by the Authority's right to perform work or to retain other contractors on portions of Project.
  - 4. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to the Authority, the Authority's employees, tenants, air carriers, and emergency vehicles at all times. Do not use driveways and entrances for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances.

- b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Utilize areas designated for Contractor staging, storage, and parking, as indicated. For additional requirements, see Section "Supplementary Conditions."
- C. Use of Existing Buildings: Maintain existing buildings in a weather tight condition throughout construction period. Repair damage caused by construction operations. Protect buildings and their occupants during construction period.
  - 1. For additional requirements for airfield and terminal buildings, see Section "Supplementary Conditions."

## 1.8 OCCUPANCY REQUIREMENTS

- A. Full Authority Occupancy: The Authority and/or its tenants will occupy site and existing building during entire construction period. Cooperate with COTR during construction operations to minimize conflicts and facilitate Authority usage, and perform the Work so as not to interfere with day-to-day Airport operations.

## 1.9 CONTRACTOR HOURS OF OPERATION

- A. Contractor Working Hours: The Authority anticipates that the Contractor may be required to work multiple shifts to accomplish the work of this Contract within the established schedule. Contractor will be allowed and may be required by the nature of the Project to work 24 hours a day, seven days a week in the performance of the Work. Work is subject to restrictions of the Airport operational requirements. Notify the COTR 24-hours in advance of any change to the work schedule.

## 1.10 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: With the exception of Federal Aviation Administration (FAA) standard specifications and Virginia Department of Transportation standard specifications the Specifications are organized into Divisions and Sections using the 33-Division format using the CSI/CSC's "MasterFormat 2004" numbering system.
  - 1. Section Identification: The Specifications use Section titles to help with cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete as all available Sections and Section numbers are not used and the CSI numbering system is not sequentially complete.

Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

- 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Interpret words and meanings as appropriate. Infer words implied, but not stated, as the sense requires. Interpret singular words as plural, and plural words as singular where applicable as the context of the Contract Documents indicates.
  2. Imperative mood and streamlined language are used in these Specifications. This imperative language is directed to the Contractor, unless specifically noted otherwise. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
    - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

#### 1.11 UTILITY OUTAGES

- A. Prior to any utility outage/interruption, prepare a schedule of such outage. Include in outage schedule duration, identification of the service affected, temporary utility service to be provided, identification of available service alternative, and the action to be taken in any emergency. Apply for all outages of utility systems in writing. Fully coordinate outage requests with COTR. Obtain approval in writing by COTR. Schedule all outages at least three (3) weeks in advance with a 96-hour notification provided by the Contractor confirming date, time, and duration. Outages will normally be scheduled to occur between the hours of 11:00 pm and 5:30 am, Tuesday through Thursday.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

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## SECTION 012200 - UNIT PRICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.
- B. The Price Proposal Form can be found in Section III, "Schedule".

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for unit prices.
- B. Related Sections include the following:
  - 1. Division 01 Section "Measurement and Payment" for procedures for measurement and payment for unit-price items.
- C. The contract will be bid as lump sum. Unit prices may be used to resolve any changes to the contract quantities.

#### 1.3 DEFINITIONS

- A. Unit price is an amount proposed by offerors, stated on the Schedule as a price per unit of measurement for materials or services added to or deducted from the Contract Price by appropriate modification according to the Contract Provision Payments. -Construction Contracts, Paragraph H, "Variation in Estimated Quantities," if estimated quantities of work required by the Contract Documents are increased or decreased.

#### 1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit. The sum of all extended unit prices in the Section III, "Schedule," shall be deemed to include all work described in the Contract Documents including Drawings and Specifications.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. The contract will be bid a lump sum. Methods of measurement and payment for unit prices are specified in those Sections and in Division 01 Section "Measurement and Payment."
- C. The Authority reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at the Authority's expense, by an independent surveyor acceptable to Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012200



## SECTION 012210 - MEASUREMENT AND PAYMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing methods of measurement and computations to be used in determination of quantities of material furnished and unit amount of Work performed under the Contract in order for Contractor to receive payment according to pre-established unit prices.
- B. At the discretion of the COTR, payment may be reduced for any Work which is not in full compliance with the Contract Documents or which has been damaged or repaired by Contractor. Such action may be used when the end product may have a reduced service life or less than desirable aesthetic characteristics.
- C. Descriptions of unit-price items are specified in Division 01 Section "Unit Prices."

#### 1.3 MEASUREMENT OF QUANTITIES

- A. The project will be bid as a lump sum. All volumes or quantities used to determine increase/decrease to the contract by unit-price payment will be measured by COTR, or by COTR's authorized representatives, using methods generally recognized as conforming to good engineering practice. Unless otherwise indicated, measurement shall be in U.S. Customary Units of Measurement.
- B. Unless otherwise indicated, longitudinal measurements for area computations will be made horizontally, and no deductions will be made for individual fixtures (or leave-outs) having an area of 9 sq. ft. or less. Unless otherwise indicated, transverse measurements for area computations will be the neat dimensions shown on Drawings.
  - 1. Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.
  - 2. Measure all Contract items measured by the linear foot, such as electrical ducts, conduits, pipe culverts, under drains, and similar items, parallel to the base of foundation on which such items are placed, unless otherwise indicated.
  - 3. In computing volumes of excavation, use the average end area method or other acceptable method.
- C. Haul materials, to be measured by volume in the hauling vehicle, in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type

acceptable to and approved in advance by COTR, provided that the body is of such shape that the actual contents may be readily and accurately determined. Load all vehicles to at least their water-level capacity. Level loads when the vehicles arrive at the point of delivery.

1. When requested by Contractor and approved by COTR in writing, material specified to be measured by the cubic yard may be weighed, and such weights will be converted to cubic yards for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by COTR and agreed to by Contractor before such method of measurement of pay quantities is used.
2. The term "ton" will mean the short ton consisting of 2000-lb avoirdupois. Weigh all materials, which are measured or proportioned by weights, on accurate, approved scales by competent, qualified personnel at locations designated by COTR.
  - a. If material is shipped by rail, the car weight may be accepted, provided that only the actual weight of material will be paid for. However, car weights will not be acceptable for material to be passed through mixing plants.
  - b. Weigh trucks used to haul material being paid for by weight empty daily at such times as COTR directs. Each truck shall bear a plainly legible identification mark.

D. The term "each" when used as an item of payment shall mean complete payment for the work described in the Contract.

1. When a complete structure or structural unit is to be provided, and "each" is specified, as the unit of measurement, the unit will be construed to include all necessary fitting, accessories, and work incidental to the work item.

E. Rental of equipment will be measured by time in hours of actual working time and necessary traveling time of the equipment within the limits of the Work. Special equipment ordered by COTR in connection with "force account work" will be measured as agreed in Contract Modification authorizing such force account work as provided in the Contract Documents.

F. When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited Specifications, manufacturing tolerances established by the industries involved will be accepted.

G. When estimated quantities for a specific portion of the Work are designated as the pay quantities in the Contract, they shall be the final quantities for which payment for such specific portion of the Work will be made, unless the dimensions of said portions of the Work shown on Drawings are revised by Contract Modification signed by the Contracting Officer.

1. If revised dimensions result in an increase or decrease in quantities of such Work, final quantities for payment will be revised in the amount represented by the authorized changes in the dimensions.

#### 1.4 PAYMENT FOR MATERIALS ON HAND

A. Partial payments may be made to the extent of the delivered cost of materials to be incorporated into the Work, provided that such materials meet the requirements of the Contract, Drawings,

and Specifications and are delivered to acceptable sites on the Airport property or at other sites in the vicinity that are acceptable to COTR. Such delivered costs of stored or stockpiled materials may be included in the next partial payment application after the following conditions are met:

1. COTR accepts the manner in which the material has been stored at or on an approved site.
  2. Contractor provides COTR with acceptable evidence of quantity and quality of the materials.
  3. Contractor provides COTR with acceptable evidence that the material and transportation costs have been paid.
  4. Contractor provides the Authority legal title, free of liens or encumbrances of any kind, to the material so stored and stockpiled.
  5. Contractor provides the Authority evidence that the material so stored or stockpiled is insured against loss by damage to or disappearance of such materials at anytime before use in the Work.
  6. Contractor provides the Authority with manufacturer's installation and maintenance information.
- B. It is understood and agreed that the transfer of title and the Authority's payment for such stored or stockpiled materials shall in no way relieve Contractor of responsibilities for furnishing and placing such materials according to the requirements of the Contract Documents.
- C. In no case will the amount of partial payments of materials on hand exceed the Contract price for the materials or the Contract price for the Contract item in which the material is intended to be used.
- D. No partial payment will be made for living or perishable plant materials.
- E. Contractor bears all costs associated with the partial payment of stored or stockpiled materials according to the provisions of this Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012210

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## SECTION 012900 – APPLICATION FOR PAYMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
  - 1. Coordinate the Schedule of Values and Applications for Payment with Contract Schedule, List of Subcontracts, and Submittal Log.
- B. Related Sections include the following:
  - 1. Division 01 Section "Unit Prices" for administrative requirements governing use of unit prices.
  - 2. Division 01 Section "Measurement and Payment" for administrative requirements governing methods of measurement and determination of quantities of materials for use with unit prices.
  - 3. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.
  - 4. Division 01 Section "Project Closeout" for submittal of items required before final payment.
  - 5. Division 01 Section "Project Record Documents" for procedural requirements governing the submission of Project Record Documents.
  - 6. Division 01 Section "Operation and Maintenance Data" for submittal of items required before final payment.

#### 1.3 DEFINITIONS

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

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
  - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

- a. Application for Payment forms with Continuation Sheets.
  - b. Submittals Schedule.
  - c. Contract Schedule.
  - d. List of products.
  - e. List of principal suppliers and fabricators.
2. Submit the Schedule of Values to Contracting Officer at earliest possible date, but no later than 21 calendar days after the date of the Notice to Proceed.
  3. Sub schedules: Where the Work is separated into phases requiring separately phased payments, provide sub schedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the Schedule of Values:
    - a. Project name and location.
    - b. Name of COTR.
    - c. Name of Architect/Engineer.
    - d. The Authority's Project number.
    - e. Contractor's name and address.
    - f. Date of submittal.
  2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or Division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Contract Modifications (numbers) that affect value.
    - g. Dollar value.
      - 1) Percentage of the Contract Price to nearest one-hundredth percent, adjusted to total 100 percent.
  3. Provide a breakdown of the Contract Price in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items under required principal subcontracts for the following items. The value assigned to the total of these line items shall be 5 percent of the Contract Price:
    - a. Testing and commissioning activities.
    - b. Operation and Maintenance manuals.
    - c. Punch list activities.
    - d. Project Record Documents.
    - e. Bonds and warranties.
    - f. Demonstration and training.

4. Round amounts to nearest whole dollar. Total shall equal the Contract Price.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Application for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - a. Differentiate between potential items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.
6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the Schedule of Values and Application for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
  - a. At COTR's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense.
8. Schedule Updating: Update and resubmit the Schedule of Values with the next Applications for Payment when Contract Modifications result in a change in the Contract Price.

#### 1.5 APPLICATION FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Contracting Officer and paid for by the Authority.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Application for Payment shall coincide with monthly schedule update, or as otherwise indicated in the Agreement between the Authority and Contractor. The period covered by each Application for Payment starts on the day following the end of the preceding period and shall not exceed one calendar month, unless otherwise approved by COTR.
- C. Payment Application Forms: Use forms provided by the Contracting Officer, but supplied by COTR, for Application 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 Authority will return incomplete applications without action.
  1. Include amounts of Contract Modifications issued before last day of construction period covered by application.
- E. Transmittal: Submit one original and four copies of Application for Payment to the address indicated in the Section VII - Contract Provision, paragraph 04.B, each one signed and notarized. Include waivers of lien and similar attachments if required.

1. Transmit Applications for Payment with a transmittal form listing attachments and recording appropriate information about application in a manner acceptable to Contracting Officer.
- F. Waivers of Mechanic's Lien: With Final Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers.
1. The Authority reserves the right to designate which entities involved in the Work must submit waivers.
  2. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to the Authority.
- G. Initial Application for Payment: Administrative actions and submittals that shall precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Contractor's Construction Schedule (preliminary if not final).
  3. Schedule of unit prices.
  4. Submittals Schedule (preliminary if not final).
  5. List of Contractor's staff assignments.
  6. Copies of building permits.
  7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  8. Initial progress report.
  9. Report of pre-construction conference.
  10. Performance and payment bonds.
  11. Initial settlement survey and damage report if required.
  12. Submittal and approval of Contractor Safety Plan.
  13. Subcontractor Payment Form: (Form J, "Contract Conditions," Section IX, "LDBE").
- H. Monthly Application for Payment: Administrative actions and submittals that shall accompany the submittal of Contractor's monthly Application for Payment include the following:
1. Subcontractor Payment Form.
  2. Monthly Progress Report, prepared according to requirements specified in Division 01 Section "Construction Progress Documentation."
  3. Evidence of payment for material on-site if reimbursement for such material is being requested.
  4. Update of Contract Record Documents.
- I. Application for Payment at Substantial Completion: After issuance of 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 Price.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Authority occupancy of designated portions of the Work, if applicable.
  3. Advise COTR of change-over in security provisions.



- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. 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 Price.
  4. Evidence that claims have been settled.
  5. Final, liquidated damages settlement statement.
  6. Return of all Airport identification badges and keys.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General project coordination procedures.
  - 2. Administrative and supervisory personnel.
  - 3. Project meetings.
    - a. Pre-construction conference.
    - b. Progress meetings.
- B. Related Sections include the following:
  - 1. Division 01 Section: "Execution" for the coordination of general installation, progress cleaning and protection of installed construction.
  - 2. Division 01 Section "Project Closeout" for coordinating Contract closeout.

#### 1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, mechanical, electrical, and otherwise. Contractor is cautioned that, where specific dimensions are not indicated or where Drawings are schematic in nature, as with most Electrical and Mechanical Drawings, Contractor shall have sole responsibility to coordinate the work to meet this requirement. Prepare and submit

Coordination Drawings to COTR for review and approval as provided in "Coordination Drawings" Paragraph in "Submittals" Article of this Section.

4. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work and completion within the specified Contract duration. 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. Start-up, check-out, and final acceptance of systems.
  7. Project closeout activities.
  8. Protection of existing and new work.
- D. Temporary Utility Outages: Comply with requirements in Division 01 Section "Summary."

#### 1.4 SUBMITTALS

- A. Coordination Drawings: Before start of the Work, prepare Coordination Drawings for areas with limited space availability that necessitate maximum utilization of space for efficient installation of different components, and areas requiring coordination for installation of products and materials fabricated by separate entities.
1. Indicate relationship of components shown on separate Shop Drawings.
  2. Indicate all dimensions provided on Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment, minimum clearance requirements, amounts of equipment and material to be installed, or other requirements. Provide alternate sketches for resolution of such conflicts to COTR for review. Minor dimension changes and difficult installations shall not be considered changes to the Contract.
  3. Indicate required installation sequences.
  4. Comply with requirements contained in Division 01 Section "Submittals."
  5. Prepare coordination drawings of involved trades in a scale of not less than 1/4 inch = 1 foot or larger for integration of different construction elements. Show sequences and relationships of separate components to avoid conflicts in use of space. Any Work installed prior to review of coordination drawings will be at the Contractor's risk and subsequent relocation require to avoid interference shall be made at no additional cost to the Authority.
- B. Key Personnel Names: At the pre-construction meeting, submit a list of Contractor's key personnel assignments. Key personnel shall include but not necessarily be limited to Project Manager, Project Superintendent, Safety Manager, Safety Engineer, Quality Control Manager,

Project Scheduler, Soil Excavation Engineers, and other personnel in attendance at Project site along with alternates. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep the list current at all times.

## 1.5 REQUESTS FOR INFORMATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, 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.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
  1. Contract Name
  2. Contract Number
  3. Date.
  4. Name of Contractor.
  5. Name of Resident Engineer
  6. Name of Task Manager
  7. RFI number, numbered sequentially.
  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 solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include drawings, descriptions, measurements, color 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. Hard-Copy RFIs:
  1. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
  1. Attachments shall be electronic files in Adobe Acrobat PDF format.
  2. RFI must be signed and scanned for electronic transmission.
  3. Hard-Copy RFI shall follow Software-Generated RFI for the record.

- E. COTR's Action: COTR will review each RFI, determine action required, and return it. Allow [seven] <7> working days for COTR'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 will 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. COTR's action may include a request for additional information, in which case COTR's time for response will start again.
  3. COTR'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.
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify COTR in writing within 3 days of receipt of the RFI response.
- F. On receipt of COTR's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify COTR within 3 days if Contractor disagrees with response.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly prior to progress meeting for inclusion in progress meeting minutes. [Include the following:]
1. Project name.
  2. Name and address of Contractor.
  3. Name of COTR.
  4. RFI number including RFIs that were dropped and not submitted.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date COTR's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

#### 1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project Superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

#### 1.7 PROJECT MEETINGS

- A. Pre-construction Conference:
1. General: COTR will schedule pre-construction conference and organizational meeting with Contractor after the Contracting Officer issues a notice of intent to award, or actually awards the Contract. The meeting will review the parties' responsibilities and personnel assignments.

- a. Minutes: COTR will record and distribute meeting minutes to all attendees and relevant parties.
2. Attendees: Contracting Officer, COTR, Architect/Engineer, and their sub-consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:
  - a. Airport security.
  - b. LBDE/MBE/WBE/DBE participation and certifications.
  - c. Authority-controlled wrap-up insurance program.
  - d. Airport Operations coordination.
  - e. Preliminary construction schedule.
  - f. Phasing.
  - g. Critical work sequencing.
  - h. Designation of key personnel.
  - i. Procedures for processing field decisions and Contract Modifications.
  - j. Procedures for processing Applications for Payment.
  - k. Distribution of the Contract Documents.
  - l. Authority Construction guidelines.
  - m. Submittal procedures.
  - n. Preparation of Record Documents.
  - o. Use of the premises.
  - p. Responsibility for temporary facilities and controls.
  - q. Parking availability.
  - r. Office, work, and storage areas.
  - s. Equipment deliveries and priorities.
  - t. Safety procedures.
  - u. Quality-control requirements.
  - v. First aid.
  - w. Progress cleaning.
  - x. Working hours.
  - y. Authority Building Code requirements/permits.
4. Refer to Contract Provision "Pre-construction Requirements" for required submittals due at the pre-construction conference.

B. Weekly Progress Meetings:

1. General: COTR will conduct progress meetings weekly at regularly scheduled times convenient for all parties involved. Progress meetings are in addition to specific meetings held for other purposes, such as coordination and special pre-installation meetings. Additionally, discussions will address administrative and technical issues of concern, determining resolutions, and development of deadlines for resolution within allowable time frames.
  - a. Minutes: COTR will record and distribute meeting minutes.

2. Attendees: As may be required by COTR, in addition to representatives of the Authority and Contractor, each subcontractor, supplier, Contractor's Project Scheduler, and other entities concerned with current progress or involved in planning, coordination, or performance of future activities. All participants at the conference 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.
  - b. Review present and future needs of each entity present, including the following:
    - 1) Safety and Security.
    - 2) Interface requirements.
    - 3) Time.
    - 4) Sequence of operations.
    - 5) Status of submittals.
    - 6) Deliveries.
    - 7) Storage Areas
    - 8) Access.
    - 9) Site utilization.
    - 10) Requests for information.
    - 11) Submittals.
    - 12) Noncompliance notices.
    - 13) Temporary facilities and controls.
    - 14) Work hours.
    - 15) Resource allocation.
    - 16) Hazards and risks.
    - 17) Progress cleaning.
    - 18) Quality and work standards.
    - 19) Contract Modifications.
    - 20) Documentation of information for payment requests.
    - 21) Preparation of Record Documents.
4. Submit at the weekly progress meeting, a two-week look-ahead schedule. This schedule shall include a three-week period, one week showing actual progress from the previous week and two weeks showing planned work for the two weeks after the meeting date. Include in the schedule all activities in sufficient detail as approved by COTR. A two-week look-ahead schedule form will be distributed at the pre-construction conference. Submit a list of subcontractors identifying dates of when subcontractors will be on-site or off-site. A form for this information will be provided by COTR.
5. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.



PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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## SECTION 013200A - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for various schedules and reports required for proper performance of the Work.
- B. All costs incurred by Contractor to correctly implement and update the schedule shall be borne by Contractor and are part of this Contract.
- C. Schedules required include the following:
  - 1. Contract Construction Progress Schedule and related narrative.
  - 2. Submittals Schedule.
  - 3. Schedule of Tests and Inspections.
  - 4. Record, As-Built Schedule.
- D. Reports required include the following:
  - 1. Daily Construction Reports.
  - 2. Material Location Reports.
  - 3. Field Correction Reports.
  - 4. Special Reports.
  - 5. Monthly Progress Reports.
  - 6. Contractor Quality Control Reports.
- E. Related Sections include the following:
  - 1. Division 01 Section "Application for Payment" for Schedule of Values.
  - 2. Division 01 Section "Project Management and Coordination" for Project meeting minutes.
  - 3. Division 01 Section "Quality Requirements" for test and inspection reports.
  - 4. Division 01 Section "Product Requirements" for Product List.

#### 1.3 DEFINITIONS

- A. Activity: The fundamental unit of work in a Project plan and schedule. Each activity has defined geographical boundaries and a detailed estimate of resources required to construct the

task. Each activity is assigned a unique description, activity number, activity codes, and dollar value.

- B. Contract Duration/Time: The total time, in calendar days identified in Section III, "Schedule," representing the duration necessary for completion of all physical and administrative requirements under this Contract and any authorized extension thereof.
- C. Critical Path: The critical path is the longest connected chain of interdependent activities that impacts the completion of the Project.
- D. Excusable Delay: An unforeseeable delay, beyond the control of Contractor, experienced due to no fault or negligence by Contractor, its subcontractors, or suppliers.
- E. Predecessor Activity: An activity that precedes another activity in the network.
- F. Successor Activity: An activity that follows another activity in the network.

#### 1.4 PLANNING

- A. The total Contract Duration and intermediate milestones if applicable, as indicated in Section III, "Schedule," are the Contract requirements.
- B. Contractor shall prepare a practical work plan to complete the Work within the Contract Duration, and complete those portions of work relating to each intermediate milestone date and other Contract requirements. Contractor shall generate a schedule for the Work.
- C. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of COTR approval of the Schedule.
- D. Failure of Contractor to comply with requirements of this Section may be considered cause for withholding progress payments or termination for default.

#### 1.5 SUBMITTALS

- A. General: Contractor shall provide all schedule submittals on computer disk media.
- B. Daily Progress Report: Submit duplicate copies to COTR by noon on the day following the date of actual progress.
- C. Monthly Progress Report: All components of the Monthly Progress Report described in this Section shall be submitted as attachments to Contractor's monthly Application for Payment.
- D. Record As-Built Schedule: A Record Schedule accurately reflecting actual progress of Work shall be submitted, as part of this Contract's Record Documents. All activities shall have actual dates that are true and accurate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DAILY CONSTRUCTION REPORTS

- A. Prepare a daily construction report, recording the following information concerning events at the site, coordinate with requirements in Division 01 Section "Quality Requirements," and submit duplicate copies to COTR by noon of the day following day of actual progress:
1. List of subcontractors (by trade group) at the site.
  2. List of separate contractors at the site.
  3. Approximate count of personnel (by trade group) at the site.
  4. Equipment (by trade group) at the site.
  5. High and low temperatures, general weather conditions.
  6. Accidents (refer to accident reports).
  7. Meetings and significant decisions.
  8. Unusual events (refer to special reports).
  9. Stoppages, delays, shortages, losses.
  10. Meter readings and similar recordings.
  11. Emergency procedures.
  12. Orders and requests of governing authorities.
  13. Change Notices/Directives and Contract Modifications received, implemented.
  14. Services connected, disconnected.
  15. Equipment or system tests and startups.
  16. Partial Completions, occupancies.
  17. Substantial Completions authorized.
  18. Material deliveries.

3.2 MATERIAL LOCATION REPORTS

- A. At weekly intervals, prepare a comprehensive list of materials delivered to and stored at the 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 all materials or items of equipment being fabricated or stored away from the building site. Submit copies of list to COTR at weekly intervals.

3.3 FIELD CORRECTION REPORT

- A. When the need to take corrective action that requires a departure from the Contract Documents arises, prepare a detailed report including a statement describing the problem and recommended changes. Indicate reasons the Contract Documents cannot be followed. Submit a copy to COTR immediately.

### 3.4 SPECIAL REPORTS

- A. When an event of unusual or significant nature occurs at the site, prepare and submit a special report. List the chain of events, persons participating, response by Contractor's personnel, an evaluation of the results or effects, and similar pertinent information. Advise COTR in advance when such events are known or predictable.
- B. Submit special reports directly to COTR within seven calendar days of an occurrence. Submit a copy to other parties affected by the occurrence.

### 3.5 DELAYS AND REQUESTS FOR EXTENSION OF TIME

- A. The determination for an extension of the Contract Time will be made by the Contracting Officer according to the Contract Provision "Default."
- B. Contractor acknowledges and agrees that delays in activities, irrespective of the party causing the delay, which do not affect any critical activity or milestone dates at the time of the delay, shall not become the basis for an extension of the Contract Time. The only basis for any extension of time will be the demonstrated impact of an excusable delay on the critical path. In demonstrating such impact, Contractor shall provide adequate detail as required by the Contract, and Contractor shall prove that:
  - 1. An event occurred.
  - 2. Contractor was not responsible for the event in that the event was beyond the control of Contractor, and was without fault or negligence of Contractor, subcontractor, or supplier, and the event was unforeseeable.
  - 3. The event was the type for which an excuse is granted according to the "Default" provision of this Contract.
  - 4. Activities on the critical path of the Work were delayed.
  - 5. The event in fact caused the delay of the Work.
  - 6. The requested additional time is an appropriate and reasonable extension of the Contract Time, given the actual delay encountered.
- C. Time Extensions for Unusually Severe Weather:
  - 1. If unusually severe weather conditions are the basis for a request for an extension of the Contract Time, such request shall be documented by data substantiating that weather conditions were abnormal for the period of time and could not have been reasonably anticipated, and that weather conditions had an adverse effect on the critical activities of the scheduled construction.
  - 2. The schedule of anticipated adverse weather below will constitute the base line for monthly (or a prorated portion thereof) weather/time evaluation by the Contracting Officer. On issuance of the Notice to Proceed and continuing throughout the Contract on a monthly basis, actual adverse weather days will be recorded by Contractor on a calendar day basis (include weekends and holidays) and compared to the monthly anticipated adverse weather days set forth below.
    - a. For purposes of this clause, the term "actual adverse weather days" shall include days that can be demonstrated to have been impacted by adverse weather.

b. Monthly Anticipated Adverse Weather Calendar Days:

- 1) January - 7.
- 2) February - 5.
- 3) March - 6.
- 4) April - 6.
- 5) May - 8.
- 6) June - 6.
- 7) July - 6.
- 8) August - 7.
- 9) September - 5.
- 10) October - 5.
- 11) November - 5.
- 12) December - 6.

c. The number of actual adverse weather days shall be calculated chronologically from the first to the last day in each month. Contractor shall not be entitled to any claim for time extension based on adverse weather unless the number of actual adverse weather days exceeds the number of anticipated adverse weather days, and unless such adverse weather days prevent work for 50 percent or more of Contractor's workday. In preparing the Contract Schedule, Contractor shall reflect the above anticipated adverse weather days on all weather-dependent activities. Weather-caused delays shall not result in any additional compensation to Contractor.

3. On days where adverse weather is encountered, Contractor shall list all critical activities under progress and shall indicate the impact adverse weather had, if any, on the progress of such activities. This information shall be presented at the end of the adverse weather day to COTR or its authorized representative for its review and approval.
4. If Contractor is found eligible for an extension of the Contract Time, the Contracting Officer will issue a modification extending the time for Contract completion. The extension of time will be made on a calendar day basis.

### 3.6 RECORD SCHEDULE

- A. After all Contract work items are complete, and as a condition of final payment, Contractor shall submit three copies of a Record Schedule showing actual start and finish dates for all work activities and milestones, based on the accepted monthly updates.

END OF SECTION 013200

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## SECTION 013300 - SUBMITTALS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.
- B. Related Sections include the following:
  - 1. Division 01 Section "Project Closeout" for submitting warranties.
  - 2. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 3. Divisions 02 through 33 Sections for specific requirements for submittals in those Sections.

#### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires COTR's responsive action.
- B. Informational Submittals: Written information that does not require COTR's approval. Submittals may be rejected for not complying with requirements.

#### 1.4 SUBMITTAL PROCEDURES

- A. General: COTR will provide electronic copies of CADD electronic files of the drawings for Contractor's use in preparing submittals.
- 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 requires sequential activity.
- C. 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.

- D. Contractor's Responsibilities: Contractor is responsible for the scheduling and submission of all submittals. Submit to COTR all required Submittals. The COTR will forward submittals to the appropriate parties for review.
- E. Processing Time: Allow enough time for submittal review, including time for re-submittals, as follows. Time for review shall commence on COTR'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 re-submittals.
1. Initial Review: Allow 7 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. COTR will advise Contractor when a submittal processed must be delayed for coordination. Allow an additional 20 calendar days for submittals related to fire-protection systems.
  2. Re-submittal Review: Allow 7 calendar days for review of each re-submittal.
  3. No extension of the Contract Time will be authorized because of failure to transmit submittals to COTR enough in advance of the Work to permit processing. Processing of incomplete or unacceptable submissions by COTR shall not reduce the number of calendar days specified above for COTR's review. Resubmissions shall be treated the same as initial submissions relative to review time.
  4. Notations on submittals that increase the Contract cost or time of completion shall be brought to COTR's attention before proceeding with the Work.
- F. 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 COTR and Architect.
  3. Include the following information on label for processing and recording action taken:
    - a. Contract name and number.
    - b. Date.
    - c. Name and address of Architect/Engineer.
    - d. Name and address of Contractor.
    - e. Name and address of subcontractor, if applicable.
    - f. Name and address of supplier, if applicable.
    - g. Name of manufacturer, if applicable.
    - h. Submittal number or other unique identifier, including revision identifier.
    - i. Alphanumeric project Identifier. Identifier is shown on the Project Drawings cover sheet.
    - j. Number and title of appropriate Specification Section.
    - k. Drawing number and detail references, as appropriate.
    - l. Location(s) where product is to be installed, as appropriate.
    - m. Transmittal number.
- G. Resubmissions: Re-submittal procedure shall follow the same procedures and same number as the initial submittal with the following exceptions:
1. Transmittal shall contain the same information as the first transmittal and the submission number shall indicate second, third, etc., submission. The drawing number/description

- shall be identical to the initial submission and the date shall be the revised date for that submission.
2. No new material shall be included on the same transmittal for a resubmission.
  3. COTR rejection shall not warrant a claim by Contractor for additional time or cost.
- H. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals. Where significant deviations from the Contract requirements exist, follow the guidelines set forth in Division 01 Section "Product Requirements" for substitutions.
- I. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal from Contractor to COTR using the approved transmittal form provided by COTR. COTR will return submittals, without review, received from sources other than Contractor.
1. Transmittal Form: Use transmittal forms and follow other submittal procedures according to information provided to Contractor at the preconstruction meeting.
- J. Distribution: Furnish 5 copies of each submittal.
- K. Use for Construction: Use only final submittals with mark indicating "approved" by COTR in connection with construction.

## 1.5 SUBMITTAL LOG

- A. Prepare a log that contains a complete listing of all submittals required by Contract. Submit the log at the preconstruction meeting along with Contractor's construction schedule specified in Division 01 Section "Construction Progress Documentation." Organize the submittal log by Section number. Assign each submittal a sequential number for identification and tracking purposes.
1. Coordinate the submittal log with Division 01 Section "Construction Progress Documentation." The submittal log shall be submitted for COTR's review. Include the following information:
    - a. Title of submittal/description.
    - b. Submittal number (sequential).
    - c. Scheduled date for the first submittal.
    - d. Drawing number, if applicable.
    - e. Applicable Section number.
    - f. Name of subcontractor/vendor.
    - g. Scheduled date of COTR's final release or approval.

## PART 2 - PRODUCTS

### 2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections

- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's written recommendations.
    - b. Manufacturer's product specifications.
    - c. Manufacturer's installation instructions.
    - d. Standard color charts.
    - e. Manufacturer's catalog cuts.
    - f. Wiring diagrams showing factory-installed wiring.
    - g. Printed performance curves.
    - h. Operational range diagrams.
    - i. Mill reports.
    - j. Standard product operating and maintenance manuals.
    - k. Compliance with recognized trade association standards.
    - l. Compliance with recognized testing agency standards.
    - m. Application of testing agency labels and seals.
    - n. Notation of coordination requirements.
  4. Submit Product Data before or concurrent with Samples.
  5. Number of Copies: Submit six copies, in addition to the number of copies to be returned to Contractor. Provide one additional copy for submittals related to fire-protection system.
  6. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Include the following information, as applicable:
    - a. Dimensions.
    - b. Identification of products.
    - c. Fabrication and installation drawings.
    - d. Roughing-in and setting diagrams.
    - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
    - f. Shopwork manufacturing instructions.
    - g. Templates and patterns.
    - h. Schedules.
    - i. Design calculations.
    - j. Compliance with specified standards.
    - k. Notation of coordination requirements.
    - l. Notation of dimensions established by field measurement.
    - m. Relationship to adjoining construction clearly indicated.
    - n. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of appropriate Specification Section.
  3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as the Authority's property, are the property of Contractor.
  4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    - a. Number of Samples: Submit three full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. COTR will return submittal with options selected.
- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product.
  2. Number and name of room or space.
  3. Location within room or space.
  4. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. COTR will return two copies.
    - a. Mark up and retain one returned copy as a Project Record Document.
- F. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements in Division 01 Section "Application for Payment."

- H. Schedule of Values: Comply with requirements in Division 01 Section "Application for Payment."
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- J. Contractor Warranty Letter: Comply with requirements in Contract Provision "Warranty of Construction." Provide the dates of warranty coverage and provide point of contact information for warranty service.
- K. Special Warranty Letters: Provide dates of warranty coverage and provide point of contact information for warranty service for special warranties required in Division 02 through 33 Sections.

## 2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
  - 1. Number of Copies: Submit four copies of each submittal, unless otherwise indicated. COTR will not return copies.
  - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. An officer shall sign certificates and certifications or other individual authorized to sign documents on behalf of that entity.
  - 3. Test and Inspection Reports: Comply with requirements in Division 01 Section "Quality Requirements."
- B. Contractor's Construction Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation."
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
- D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- J. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.
- K. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- L. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.
- M. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. 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.
- N. Research/Evaluation Reports: Prepare written evidence from a model code organization acceptable to the Authority that product complies with USBC. Include the following information:
  - 1. Name of evaluation organization.
  - 2. Date of evaluation.
  - 3. Time period when report is in effect.
  - 4. Product and manufacturers' names.
  - 5. Description of product.
  - 6. Test procedures and results.
  - 7. Limitations of use.
- O. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 01 Section "Operation and Maintenance Data."
- P. Design Data: Prepare written and graphic information, including, but are not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

- Q. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
  2. Required substrate tolerances.
  3. Sequence of installation or erection.
  4. Required installation tolerances.
  5. Required adjustments.
  6. Recommendations for cleaning and protection.
- R. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement on whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- S. Bonds: Prepare written information indicating current status of bonding coverage. Include name of entity covered by insurance or bond, limits of the coverage, amounts of deductibles, if any and term of coverage.
- T. Manufacturers' warranties.
- U. Material Safety Data Sheets: Submit information directly to COTR.

### PART 3 - EXECUTION

#### 3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to COTR.
1. In checking Shop Drawings and Product Data, verify all dimensions and field conditions and check and coordinate Shop Drawings and Product Data of any Section or trade with the requirements of other sections or trades as related thereto, as required for proper and complete installation of the Work.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, 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, which shall include dimensions, clearances, compatibility, and coordination with Shop Drawings and Product Data submitted for other work.

- C. If Contractor has not checked the submittals carefully, even though stamped as checked and approved, submittals shall be returned to Contractor for proper checking before further processing or review by COTR regardless of any urgency claimed by Contractor. In such a situation, Contractor will be responsible for any resulting delays to the scheduled Contract completion. Furthermore, Contracting Officer may hold Contractor responsible for increased Authority costs resulting from Contractor's failure to comply with the requirements set forth herein.

### 3.2 COTR'S ACTION

- A. General: COTR will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. COTR Responsibilities: The review of Shop Drawings and other submittals by COTR will be for general conformance with the Contract only, and the review shall not be interpreted as a checking of detailed dimensions, quantities, or approval of deviations from the Contract Documents. COTR review shall not relieve Contractor of its responsibility for accuracy of Shop Drawings nor for the furnishing and installation of materials or equipment according to the Contract requirements.
  - 1. Approval of Shop Drawings or other submittals is not to be interpreted as approval of a substitute material. Approval of substitutions will be accomplished according to requirements set forth in Division 01 Section "Product Requirements."
- C. Action Submittals: COTR will review each submittal, make marks to indicate corrections or modifications required, and return it. COTR will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows. Do not permit submittals marked "Revise and Resubmit" or "Rejected" to be used at Project site, or elsewhere where Work is in progress.
  - 1. Approved: Means fabrication/installation may be undertaken. Approval does not authorize changes to the Contract Price or the Contract Time.
  - 2. Approved as Corrected: Same as "Approved," providing Contractor complies with corrections noted on submittal. Resubmission required only if Contractor is unable to comply with noted corrections.
  - 3. Revise and Resubmit: Fabrication and/or installation may not be undertaken. Make appropriate revisions and resubmit, limiting corrections to items marked.
  - 4. Rejected: Submittal does not comply with requirements. Fabrication and/or installation may not be undertaken. Prepare a new submittal according to requirements and submit without delay.
- D. Informational Submittals: COTR will review each submittal and will not return it, or will reject and return it, if it does not comply with requirements. COTR will forward each submittal to appropriate party.

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

END OF SECTION 013300

## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.
- B. Related Sections:
  - 1. Division 01 Section “Submittals” for process required to submit the Contractor’s Quality Control Plan.
  - 2. Division 01 Section “Construction Progress Documentation” for developing a schedule of required tests and inspections.
  - 3. Division 01 Section “Project Closeout”
  - 4. Division 01 Section “Cutting and Patching” for repair and restoration of construction disturbed by testing and inspecting activities.
  - 5. Divisions 02 through 33 Sections for specific test and inspection requirements.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Administrative and procedural requirements for Contractor to provide and maintain an effective Quality-Control Program that complies with this Section and with requirements of the "Contract Provisions," Section VII, "Inspection of Construction and Final Inspection and Acceptance."
  - 2. Establish a QC Program that consists of the following:
    - a. QC Organization
    - b. QC Plan
    - c. QC Plan Meeting
    - d. Coordination and Mutual Understanding Meeting
    - e. QC meetings
    - f. Phases of Control
    - g. Submittal review and approval
    - h. Operation & Maintenance data and Warranty receipt verification prior to product delivery
    - i. Material verification at delivery
    - j. Testing, completion inspections, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations that comply with the requirements of this Contract.
  - 3. Contractor shall provide Special Inspection services according to requirements of the current Virginia Uniform Statewide Building Code (USBC). Contractor shall engage a

third-party inspection agency to perform all USBC special inspections, if required, and prepare all inspection reports, certifications, and summary letters. Submit reports, certifications, and summary letters to COTR. Provide additional copies of all reports, certifications, and summary letters to the Authority Building Codes/Environmental Department and the Architect/Engineer of record as required by the USBC. Throughout the IBC portion of the USBC, substitute "Contractor" for "Owner." Provide Special Inspections for all concrete construction including footings of buildings.

a. Special inspections are required for, but are not necessarily limited to, the following:

- 1) Steel construction.
- 2) Concrete construction.
- 3) Masonry construction.
- 4) Foundation systems including concrete footings of buildings three stories or less in height which are fully supported on earth or rock.
- 5) Prepared fill requirements.

4. Specific quality-control requirements for individual construction activities are specified in the Sections that require those activities. Requirements in those Sections may also cover production of standard products.
5. Schedule of Values: Contractor shall include all test and inspection activities in its CPM and establish a Schedule of Values for all quality test and inspection activities; and all required reports, and procedures required in the Contract on a Section-by-Section basis. Additionally, Contractor shall include a pay line item specifically for CQC activities and QCM position(s) required by the General Conditions. CQC activities shall be reported per Division 01 Section "Applications for Payment."
6. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of its responsibilities for compliance with the Contract Document requirements.
7. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
8. The provisions of this Section shall not limit requirements for Contractor to provide quality-control services required by the Authority or other agencies having jurisdiction.

### 1.3 REFERENCES

#### 1. METROPOLITAN WASHINGTON AIRPORT AUTHORITY

- a. *Construction Safety Manual*, most current edition

### 1.4 DEFINITIONS

- A. Quality: Conformance to the requirements established by the contract specifications and drawings.

- B. Control: To guide and have influence over.
- C. Contractor Quality Control (CQC): The construction contractor's system to manage, control, and document their own, their supplier's, and their subcontractor's activities to comply with the contract requirements.
- D. Contracting Officers Technical Representative (COTR). Primary on-site representative of the Contracting Officer for technical matters. Duties and responsibilities of the COTR will be transmitted to the contractor via letter from the Contracting Officer.
- E. Quality-Assurance Services: Activities, actions, and procedures performed by the Authority before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirement. Additionally, the Authority fulfills its responsibility to be certain that the CQC is functioning and the specified end product is achieved.
- F. Definable Feature of Work: A definable feature of work (DFOW) is a task, which is separate and distinct from other tasks, has the same control requirements and work crews.
- G. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of 10 projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction. Specific experience requirements enumerated in these specifications supersede this requirement.

#### 1.5 CONFLICTING REQUIREMENTS

- A. General: If compliance with two standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to the COTR for a decision before proceeding. This paragraph refers to industry and government standards. In case of a difference between drawings and the specifications, the specifications shall govern.

#### 1.6 SUBMITTALS

- A. Submit the following in accordance with Division 01 Section, "Submittals."
  - 1. Action Submittals.
    - a. Quality Control (QC) Plan.
- B. NOTE: Coordinate the submittal requirement dates with the submittal dates in Division 01 Section "Construction Progress Documentation".
- C. Submit a QC plan within 10 calendar days after receipt of Notice to Proceed. The QC Plan shall include a preliminary submittal of the list of definable features of work that shall cover the entire construction duration.

1. Submit at this time résumés of key personnel to be assigned to this contract and the limits of their authority. Show how this project management structure fits into the Contractor's corporate management structure.
- D. Any approval by the COTR of the QC Plan shall be treated as "accepted, predicated upon successful implementation." Stop work if the QC Plan becomes disapproved. The exception is the work authorized in the paragraph entitled "Preliminary Work Authorized Prior to Approval," shall stop.

#### 1.7 INFORMATION FOR THE CONTRACTING OFFICER

- A. Provide a sample copy set of report forms to the Contracting Officer during the Pre-Construction Conference. The report forms shall consist of the Quality Control Daily Report.
- B. Deliver the following listed items to the COTR at the times specified:
  1. Quality Control Daily Report: Original and 6 copies, by 12:00 noon the next working day after each day that work is performed.
  2. Superintendent's Daily Report: Original and 6, by 12:00 noon the next working day after each day that work is performed, attached to the Quality Control Daily Report.
  3. Field Test Reports: 2 copies, within 2 working days after the test is performed, do not attach to the Quality Control Daily Report.
  4. Monthly Summary Report of Tests: 2 copies, do not attach to a Quality Control Daily Report.
  5. Inspection Log and Signoff Sheets: one copy, submitted daily within 1 day of the inspection.
  6. Testing Plan and Log: 2 copies, submitted within 2 working days of the end of the month.
  7. Monthly Deficiency Report: 2 copies within two working days of the end of the month.

#### 1.8 QC PROGRAM REQUIREMENTS

- A. Establish and maintain a QC Program as described in this Section. The QC Program consists of but is not limited to the following:
  1. QC Organization.
  2. QC Plan.
  3. QC Plan Meeting.
  4. Coordination and Mutual Understanding Meeting
  5. QC meetings.
  6. Phases of Control.
  7. Submittal review and approval.
  8. Operations and Maintenance data.
  9. Warranty receipt verification prior to product delivery.
  10. Material verification at delivery.
  11. Testing.
  12. Completion inspections.
  13. QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations that comply with the requirements of this Contract.

14. The QC Program shall cover on-site and off-site work and shall be keyed to the work sequence.
15. No work or testing may be performed unless the QCM or a pre-approved alternate is on the work site.
16. The QCM shall report to an officer of the firm and shall not be subordinate to the Project Superintendent or the Project Manager.
17. Quality Control Manager is the primary individual responsible for quality control. The QCM, Project Superintendent and Project Manager shall be responsible for the quality of work on the job. Project Superintendent shall be held responsible for the quality of production.

B. Preliminary Work Authorized Prior to Approval

1. The only work that is authorized to proceed prior to the approval of the QC Plan is mobilization of storage and office trailers, temporary utilities, and surveying.

C. Approval

1. Approval of the QC Plan is required prior to the start of any construction. The Contracting Officer reserves the right to require changes in the QC Plan and operations as necessary, including but not limited to removal of personnel, to ensure the specified quality of work. The Contracting Officer reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications. All QC organization personnel shall be subject to acceptance by the Contracting Officer. The Contracting Officer may require the removal of any individual for non-compliance with quality requirements specified in the contract.

D. Notification of Changes

1. Notify the COTR, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes shall be subject to acceptance by the Contracting Officer.

1.9 QC ORGANIZATION

A. Staffing Levels: Provide sufficient qualified quality-control personnel to monitor each work activity at all times. Scheduling and coordinating of all inspections and testing shall match the type and pace of work activity.

1. In cases where multiple trades, disciplines, or subcontractors are on site at same time, each activity shall be tested and inspected by personnel skilled in that portion of the work.
2. In cases where multiple shifts are employed, the quality-control staff shall be increased as required to monitor the work on each shift.
3. Project Superintendent
  - a. Qualifications: Fifteen years of experience, with five years experience in a supervisory role coordinating various trades at multiple work areas.

1.10 QC PLAN MEETING

- A. Within 10 calendar days of notice of award and prior to submission of the QC plan, meet with the COTR to discuss the QC plan requirements of this Contract. The purpose of this meeting is to communicate expectations and facilitate understanding of the QC plan requirements prior to plan development and submission.

1.11 QUALITY CONTROL (QC) PLAN

- A. Provide, for approval by the COTR, a QC plan submitted in a 3-ring binder with pages numbered sequentially that covers both on-site and off-site work and includes but may not necessarily be limited to the following:
  - B. A table of contents listing the major sections identified with tabs in the following order:
    - 1. QC ORGANIZATION
    - 2. PERSONNEL MATRIX
    - 3. NAMES AND QUALIFICATIONS
    - 4. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL
    - 5. APPOINTMENT LETTERS
    - 6. OUTSIDE ORGANIZATIONS INCLUDING BOCA INSPECTION COMPANIES
    - 7. TESTING LABORATORY INFORMATION AND CERTIFICATIONS
    - 8. TESTING PLAN AND LOG
    - 9. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER
    - 10. LIST OF DEFINABLE FEATURES
    - 11. PROCEDURES FOR PERFORMING THE PHASES OF CONTROL
    - 12. SPECIAL INSPECTIONS
    - 13. DOCUMENTATION PROCEDURES
    - 14. PROCEDURES TO COMPLETE REWORK ITEMS
    - 15. PROCEDURES FOR COMPLETION INSPECTION
    - 16. FORMS
    - 17. ATTACHMENTS
- C. Letters signed by an officer of the firm appointing the Quality Control Manager stating that they are responsible for implementing and managing the QC Program as described in this contract. Include in this letter the responsibility of the QCM to implement and manage the three phases of quality control, and their authority to stop work that is not in compliance with the contract. The QCM shall issue letters of direction to all other QC specialists outlining their duties, authorities, and responsibilities. Copies of the letters shall be included in the QC plan.
- D. A listing of outside organizations such as, architectural and consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.
- E. Testing laboratory information required by the paragraphs entitled "Accreditation Requirements" or "Construction Materials Testing Laboratory Requirements", as applicable.
- F. A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, the desired results and the person responsible for each test and shall be identified as a scheduled (CPM) activity.



- G. Procedures for reviewing, approving and managing submittals. Provide the name(s) of the person(s) in the QC organization authorized to review and certify submittals prior to approval. Provide the initial submittal of the Submittal Register as specified in Section entitled "Submittals."
  - H. List of definable features of work. The list shall be cross-referenced to the contractor's Construction Schedule and the specification sections. For projects requiring a Progress Chart, the list of definable features of work shall include but not be limited to all items of work on the schedule. For projects requiring a Network Analysis Schedule, the list of definable features of work shall include but not be limited to all critical path activities. Include a chart of common deficiencies for the Definable Feature of work. Detail the control procedures that shall be employed to eliminate this common deficiency.
  - I. Procedures for Performing the Phases of Control. The contractor shall develop a plan for incorporating each of the control phases into the work. The plan shall detail who shall be responsible for scheduling the phases, conducting the phase as well as documenting the phase. The use of project specific forms may be helpful. However, the entire plans and specifications establish the quality and not just the checklists. The Preparatory and Initial Phases and meetings shall be conducted with a view towards obtaining quality construction by planning ahead and identifying potential problems for each definable feature of work.
  - J. Include all activities for which this specification requires QC specialists or Specialty Inspection Personnel, and for any specific definable features of work as identified in the QC Plan.
  - K. Documentation procedures, including proposed report formats.
  - L. Procedures to identify, record, track and complete rework items.
  - M. Procedures for Identifying and Documenting the Completion Inspection process. Include in these procedures the responsible party for punch out inspection, pre-final inspection, and final acceptance inspection.
  - N. A complete set of report forms to be utilized on this project.
  - O. All applicable subcontractors and suppliers Quality Control Plans complete with Contactor's CQC planned involvement.
- 1.12 SUBMITTAL REVIEW AND APPROVAL
- A. Procedures for submission, review and approval of submittals are described in Division 01 Section "Submittals".
- 1.13 TESTING
- A. Except as stated otherwise in the technical specification sections, perform sampling and testing required under this Contract.
  - B. Independent Testing Laboratory: When tests are required by civil, electrical, USBC and other codes in effect, a corporately and financially independent testing organization that can function

as an unbiased testing authority, professionally independent of manufacturers, suppliers, and installers of equipment, or systems evaluated by the testing organization shall be contracted by the Contractor to perform the contractually required tests. The various types of independent laboratories and their requirements are listed below:

- C. Accreditation Requirements: Construction materials testing laboratories performing work for Authority construction contracts shall be accredited by one of the laboratory accreditation authorities. The laboratory's scope of accreditation shall include the ASTM standards listed in the paragraph titled "Construction Materials Testing Laboratory Requirements" as appropriate to the testing field. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office".
- D. Electrical testing of components, equipment and systems: The testing firm shall be regularly engaged in the testing of electrical equipment, devices, installations, and systems. The testing firm shall have at least five years experience in the testing of electrical equipment of the type, rating, and voltage used on this Project. The testing laboratories shall be a current full-member company of the International Electrical Testing Association (<http://www.neta.org/>). This independent testing firm shall perform duties as required under the terms of this Contract.
- E. Structural and Pipe Welding: An independent testing firm shall perform all structural and pipe welding examinations as required by this Contract. The inspectors employed by the firm shall hold current certification as an AWS Certified Welding Inspector (CWI) for visual weld examinations and ASNT-TC-1A Certification for nondestructive examination of welds. ASNT-TC-1A certifications shall be by an ASNT-TC-1A ACCP Level III.
- F. Test Results: Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify COTR immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. A testing laboratory representative authorized to sign certified test reports shall sign test results. Furnish the signed reports, certifications, and other documentation to the COTR via the QCM. Furnish a summary report of field tests at the end of each month. Attach a copy of the summary report to the last daily Quality Control Daily Report of each month.
- G. Test Reports and Monthly Summary Report of Tests:
  - 1. The QCM shall furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the COTR. Attach a copy of the summary report to the last daily Quality Control Daily Report of each month.
- H. Control and Verification Tests: Control tests are those tests made for Contractor under the Quality Control Plan to assist Contractor in maintaining control of his operations. As described above, Contractor shall procure the services of an independent commercial laboratory to perform the required control tests. The Specifications contain the minimum of the following:
  - 1. Testing criteria
  - 2. Frequency of testing
  - 3. Procedures
  - 4. Methods of construction
  - 5. Number of control tests to be made for each phase of the Work.

6. Notify COTR a minimum of 24 hours in advance of the time samples shall be taken by Contractor for quality control testing. COTR shall then notify its own testing laboratory contractor so that verification test samples may be taken.
- I. Check Tests: Contractor shall furnish to COTR the quantities of materials to be used for check testing as required in the Specifications. Check testing shall be performed by the Authority at an independent laboratory at no cost to Contractor. No direct payment shall be made to Contractor for the furnishing of materials used for check testing.
- J. Staffing: All laboratory personnel shall work under the supervision of a Professional Engineer licensed in the Commonwealth of Virginia.

#### 1.14 COMPLETION INSPECTIONS

- A. Punch-Out Inspection: Near the completion of all work or any increment thereof established by a completion time stated in the Contract Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the QCM shall conduct an inspection of the work and develop a "punch list" of items which do not conform to the approved drawings and specifications. Include in the punch list any remaining items on the "Rework Items List" which were not corrected prior to the Punch-Out Inspection. The punch list shall include the estimated date by which the deficiencies will be corrected. A copy of the punch list shall be provided to the COTR. The QCM or staff shall make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished the Contractor shall notify the COTR that the facility is ready for the Authority "Pre-Final Inspection."
- B. Pre-Final Inspection: The Authority will perform this inspection to verify that the facility is complete and ready to be occupied. An Authority "Pre-Final Punch List" may be developed as a result of this inspection. The QCM shall ensure that all items on this list are corrected prior to notifying the Authority that a "Final" inspection with the customer can be scheduled. Any items noted on the "Pre-Final" inspection shall be corrected in timely manner and shall be accomplished before the contract completion date for the work or any particular increment thereof if the project is divided into increments by separate completion dates.
- C. Final Acceptance Inspection: The superintendent or other primary contractor management personnel shall be in attendance at this inspection. The COTR will be in attendance at this inspection. Additional Authority personnel may be in attendance. The Contracting Officer based upon results of the "Pre-Final" inspection will formally schedule the final acceptance inspection. Notice shall be given to the COTR at least 14 calendar days prior to the final inspection stating that all specific items previously identified to the Contractor, as being unacceptable, along with all the remaining work performed under the contract, shall be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection shall be cause for the Contracting Officer to bill the Contractor for the Authority's additional inspection cost in accordance with the clause in the Contract Provisions entitled "Inspection of Construction." When the Contracting Officer takes possession of partially completed work, it shall be in accordance with clause in the Contract Provisions entitled "Use and Possession Prior to Completion".

## 1.15 DOCUMENTATION

- A. Contractor shall maintain current quality control records, on approved forms, of all control activities, production, tests and inspections performed. These records shall include factual evidence that required tests or inspections have been performed, including type and number of tests or inspections involved; results of tests or inspections; nature of defects, causes for rejection, etc.; proposed remedial action; and corrective actions taken. These records shall cover both conforming and defective or deficient features (non-conforming) and shall include a statement that all supplies and materials incorporated into the Work are in full compliance with terms of the Contract. Legible copies of these records shall be furnished to COTR daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified by Contractor's QCM. Contractor shall document tests and inspections as specified in the technical provisions of the Specifications, and these records shall be available for review by COTR throughout the life of the Contract.
- B. Maintain current and complete records of on-site and off-site QC Program operations and activities. Establish and maintain the following in a series of 3 ring binders. Binders shall be divided and tabbed as shown below. These binders shall be readily available to the Authority's Quality Assurance Team during normal business hours.
1. All completed Preparatory and Initial Phase Reports, arranged by specification Section.
  2. All milestone inspections, arranged by Activity/Event Number.
  3. A current up-to-date copy of the Testing Plan and Log with supporting field test reports, arranged by specification section.
  4. Copies of all contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.
  5. A current, up-to-date copy, of the Deficiency List.
- C. Report Forms - The contractor shall design all forms to be used in the Quality Control Program. A copy of all forms shall be included with the Quality Control Plan. The forms shall be designed to assist in the control of the quality. The following minimum requirements are listed for specific reports:
1. Quality Control Daily Report: Reports are required for each day that work is performed and for every seven consecutive calendar days of no work and on the last day of a no-work period. Account for each calendar day throughout the life of the Contract. The reporting of work shall be identified by terminology consistent with the construction schedule. Quality Control Daily Reports are to be prepared, signed and dated by the QCM and shall contain the following information:
    - a. Date of report, report number, Contract Number, and Contract Title.
    - b. Identify Schedule Activity No., Submittal # and list equipment/material received each day that is incorporated into the job.
    - c. Indicate if Preparatory Phase work was performed today (Yes/No checkboxes).
    - d. If Preparatory Phase work was performed today (including on-site and off-site work), identify its Schedule Activity Number and Definable Feature of Work. The Index number is a cross reference to the Preparatory Phase Checklist. An example of the Index number is: 0025-P01, where "0025" is the Quality Control Daily Report Number, "P" indicates Preparatory Phase, and "01" is the Preparatory Phase Checklist number(s) for this date. Each entry in this Section shall be accompanied with a corresponding Preparatory Phase Checklist.

- e. Indicate if Initial Phase work was performed today (Yes/No checkboxes).
  - f. If Initial Phase work was performed today (including on-site and off-site work), identify its Schedule Activity Number and Definable Feature of Work. The Index Number is a cross reference to the Initial Phase Checklist. An example of the Index Number is: 0025-I01, where "0025" is the Quality Control Daily Report Number, "I" indicates Initial Phase, and "01" is the Initial Phase Checklist number(s) for this date. Each entry in this Section shall be accompanied with a corresponding Initial Phase Checklist.
  - g. Results of the Follow-up Phase inspections held today (including on-site and off-site work), including Schedule Activity Number, location of definable feature of work, Specification Sections, etc. Indicate in the report for this definable feature of work that the work complies with the Contract as approved in the Initial Phase, work complies with safety requirements, and that required testing has been performed. Include a list of who performed the tests.
  - h. List the rework items identified, but not corrected by close of business, along with its associated Schedule Activity Number.
  - i. List the rework items corrected from the rework items list along with the corrective action taken and its associated Schedule Activity Number.
  - j. Include a "remarks" section in this report that shall contain pertinent information including but not limited to:
    - 1) Directions received.
    - 2) Quality control problem areas.
    - 3) Deviations from the QC plan.
    - 4) Construction deficiencies encountered.
    - 5) QC meetings held,.
    - 6) Acknowledgement that record drawings, specifications, O & M data, and Warranty Manuals, have been updated.
    - 7) Corrective direction given by the QC Organization and corrective action taken by the Contractor.
    - 8) For each remark given, identify the Schedule Activity Number that is associated with the remark.
  - k. Quality Control Daily Report certification, signature and date.
2. Preparatory Phase Report: Each Definable Feature of Work that is in the Preparatory Phase shall have this report filled out for it. The report shall be identified by terminology consistent with the construction schedule. Attach this report to the Quality Control Daily Report of the same date.
- a. Specification Section, date of report, and Contract number shall be filled out. Duplicate this information in the header of the second page of the report.
  - b. Definable Feature of Work, Schedule Activity Number and Index Number entry and format shall match entry in the Preparatory Phase section of the Quality Control Daily Report. Duplicate this information in the header of the second page of the report.
  - c. Personnel Present: Indicate the number of hours of advance notice that was given to the COTR and indicate (Yes/No checkboxes) whether or not the COTR was notified. Indicate the Names of Preparatory Phase Meeting attendees, their position and their company affiliation.

- d. Submittals: Indicate if submittals have been approved (Yes/No checkboxes), if no indicate what has not been submitted. Are materials on hand (Yes/No checkboxes) and if not, what items are missing. Check delivered material/equipment against approved submittals and comment as required.
  - e. Material Storage: Indicate if materials/equipment is stored properly (Yes/No checkboxes) and if not, what action is/was taken.
  - f. Specifications: Review and comment on Specification Paragraphs that describe the material/equipment, procedure for accomplishing the work and clarify any differences.
  - g. Preliminary Work & Permits: Ensure preliminary work is in accordance with the contract documents and necessary permits are on file, if not, describe the action taken.
  - h. Testing: Identify who performs tests, the frequency, and where tests are to occur. Review the testing plan, report abnormalities, and if the test facilities have been approved.
  - i. Discuss Control Procedures that shall be employed to consistently obtain the required specified quality.
  - j. Safety: Indicate if the activity hazard analysis has been approved (Yes/No checkboxes) and comment on the review of the applicable portions of the Construction Safety Manual.
  - k. Meeting Comments: Note comments and remarks during the Preparatory Phase Meeting that was not addressed in previous sections of this checklist.
  - l. Other Items or Remarks: Note any other remarks or items that were a result of the Preparatory Phase.
  - m. QCM shall sign and date the report.
3. Initial Phase Report: Complete this report for each Definable Feature of Work that is in the Initial Phase. The report shall be identified by terminology consistent with the construction schedule. Attach this report to the Quality Control Daily Report of the same date.
- a. Specification Section, date of report, and Contract number shall be entered.
  - b. Definable Feature of Work, Schedule Activity Number and Index Number entry and format shall match entry in the Initial Phase section of the Quality Control Daily Report.
  - c. Personnel Present: Indicate the number of hours of advance notice that was given to the COTR and indicate (Yes/No checkboxes) whether or not the COTR was notified. Indicate the Names of Initial Phase Meeting attendees, their position and company/Authority they are with.
  - d. Control Procedures: Comment on control procedures identified at Preparatory Phase of Control and assurance that work is in accordance with plans, specifications and submittals. Control procedures not producing the required compliance shall be adjusted until the procedures consistently obtain the required quality.
  - e. Preliminary Work: Ensure preliminary work being placed is in compliance and if not, what action is/was taken.
  - f. Workmanship: Identify where initial work is located; if a sample panel is required (Yes/No checkboxes); is the initial work the sample (Yes/No checkboxes); and if Yes, describe the panel location and precautions taken to preserve the sample.
  - g. Resolution: Comment on any differences and the resolutions reached.
  - h. Check Safety: Comment on the safety review of the job conditions.

- i. Other: Note any other remarks or items that were a result of the Initial Phase.
  - j. QCM shall sign and date the report.
- D. Special Inspection Control Log: Contractor shall maintain a Special Inspection Control Log chronologically recording each Special test and inspection performed under the USBC, or other agencies having jurisdiction on-site, including the nature of the test or inspection, the date performed, the results, causes for rejection, corrective action taken, and dates of subsequent tests and final acceptance.
- E. Test Reports: Contractor shall be responsible for establishing a system that shall record all tests results. Information on test designation, location, date of test, specification requirements, results and retest results, causes for rejection and recommended remedial actions shall be documented. A copy of the test results shall be sent directly from the Agency performing the testing services to COTR. A copy of any failing report shall be sent immediately. All test reports shall be reviewed and signed by a professional engineer, licensed in the Commonwealth of Virginia.
- F. Signoff Sheets: Contractor shall be responsible for establishing a system of signoff sheets certifying that all work required before the construction or startup of critical work elements has been constructed and installed according to the plans and specifications.
- G. Monthly Deficiency Report: Contractor shall submit a monthly deficiency report to COTR identifying all substandard tests and inspections taken during the month including the nature of the test or inspection, location and nature of defects, causes for rejection, and remedial actions taken or proposed for any open items on prior deficiency reports including the date scheduled for resolution of the item.
- H. Record Drawings: The QCM is required to ensure the record drawings, required by Division 01 Section "Project Record Documents," are kept current on a daily basis and marked to show deviations which have been made from the construction drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g. CN No., Modification No., Request for Information No., etc.). The QCM shall initial each deviation and each revision. Upon completion of work, the QCM shall furnish a certificate attesting to the accuracy of the record drawings prior to submission to the COTR.

#### 1.16 NOTIFICATION ON NON-COMPLIANCE

- A. The COTR will notify the Contractor of any detected non-compliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may:
  - 1. Issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall make no part of the time lost due to such stop orders the subject of a claim for extension of time for excess costs or damages.
  - 2. Repair, replace or otherwise remedy the defective work at the Contractor's expense. Cost incurred by the Authority to correct defective work shall be deducted from the total amount due the Contractor.
  - 3. Withhold an amount from the payment due the Contractor as may be deemed necessary at the discretion of the Contracting Officer.

4. Terminate the Contractor's right to proceed for Default after providing required notice.
- B. In cases where implementation of the Quality Control Program does not comply with the Contractor's Quality Control Plan or the contract provisions. Or Contractor fails to properly operate and maintain an effective Quality Control Program, the Contracting Officer may:
1. Order the Contractor to replace ineffective or unqualified Quality Control Personnel or subcontractors.
  2. Issue an order stopping all or part of the work until acceptable personnel are on site and a new Quality Control Plan is approved by the COTR. The Contractor shall make no part of the time lost due to such stop orders the subject of claim for extension of time for excess costs or damages.
  3. Take a credit from the contract for Quality Control Activities not performed.
  4. Terminate the Contractors right to proceed for Default after providing required notice.
- C. The Contractor shall maintain a detailed record of every non-compliance and corrective action taken.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014000



## SECTION 017113 - MOBILIZATION/DEMOBILIZATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This work shall consist of the performance of construction preparatory operations, including the movement of personnel, equipment, and materials to the project site, and for establishment and maintenance of the contractor's facilities necessary to begin and sustain work on the Contract. In addition, the following items are to be included in the cost of mobilization:
  - 1. Obtaining personnel identification and other items as necessary to facilitate work.
  - 2. Deliver necessary equipment as needed to complete the project.
  - 3. Prepare various plans and other items as necessary to facilitate work as outlined in the contract documents.
  - 4. Recurring costs for record documentation for the duration of the project.
  - 5. Other work items necessary to begin construction, as shown in the plans.
  - 6. Demobilization efforts at completion of the Project.

#### 1.3 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- A. Mobilization will not be measured and shall be included in the contract lump sum price.

### PART 2 - PRODUCTS (NOT USED)

### PART 3 - EXECUTION (NOT USED)

END OF SECTION 017113

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## SECTION 017300 - EXECUTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. General installation of products.
  - 4. Coordination of Authority-installed products or installed by others.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
  - 8. Correction of the Work.
- B. Related Sections include the following:
  - 1. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.

#### 1.3 SUBMITTALS

- A. Project Record Documents: Submit a record of Work performed (materials tests, inspections, acceptance tests, etc.) and record survey data as required under provisions in Division 01 Sections "Submittals" and "Project Closeout."

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
    - a. Description of the Work.
    - b. List of detrimental conditions, including substrates.
    - c. List of unacceptable installation tolerances.
    - d. Recommended corrections.
  - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to COTR 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.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information (RFI) to COTR. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify existing information shown on Drawings.

### 3.4 INSTALLATION

- A. Inspection of Conditions: Require Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Proceed only after unsatisfactory conditions have been corrected in a manner acceptable to COTR. Coordinate this requirement with Division 01 Section "Quality Requirements."
- B. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
  - 4. Maintain minimum headroom clearance of 8' in spaces without a suspended ceiling.
  - 5. Roughing-in of utilities in areas with vaulted or domed roofs shall follow contour of roof lines.
- C. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- D. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- E. 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.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels. For additional requirements see Section "Supplementary Conditions."
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by COTR.
  - 2. Allow for building movement, including thermal expansion and contraction.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints as directed by COTR. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.5 AUTHORITY-INSTALLED PRODUCTS

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

### 3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Remove combustible debris from the site daily.
  - 3. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
  - 4. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
  - 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-airport property will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. 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.
- J. 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.

### 3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure that installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

### 3.8 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

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## SECTION 017329 - CUTTING AND PATCHING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
  - 1. Divisions 02 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

#### 1.3 DEFINITIONS

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

#### 1.4 QUALITY ASSURANCE

- A. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Obtain COTR's written approval of the cutting and patching of the following operating elements or safety related items:
  - 1. Fire-suppression systems.
  - 2. Control systems.
  - 3. Communication systems.
  - 4. Security systems including CCTV and duress alarms.
- B. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related 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. Miscellaneous elements include the following:
  - 1. Piping, ductwork, vessels, and equipment.
- C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or

in occupied spaces in a manner that would, in COTR's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1. Terrazzo.

- D. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

- D. 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.

### 3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. 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. Remove conductors back to source of supply.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
  - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface

containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.

END OF SECTION 017329

## SECTION 017700 - PROJECT CLOSEOUT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and other Division 01 Specification Sections apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project closeout, including, but not limited to, the following:
  - 1. Inspection procedures.
  - 2. Warranties.
  - 3. Final cleaning.
- B. Related Sections include the following:
  - 1. Division 01 Section "Quality Requirements" for final requirements of the Warranty Manual.
  - 2. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, Record Product Data, and other Record Documents.
  - 3. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for products of those Sections.

#### 1.3 SUBSTANTIAL COMPLETION

- A. Definition: "Substantial Completion" is the stage in the progress of the work when COTR determines that all the Work, or a designated portion thereof, is sufficiently complete and functional according to the Contract Documents so that the Authority can occupy or utilize the Work for its intended use. The only remaining physical work shall be the completion of punch list work prior to Final Acceptance.
- B. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, reasons why the Work is not complete, and a schedule for completing punch list work according to Section III of the Contract.
  - 2. Ensure previously outstanding technical submittals and Shop Drawings have been submitted and approved.
  - 3. Submit warranties required by Contract Documents, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

- a. Submit Contractor Warranty Letter, for review and approval, before requesting inspection for determining date of Substantial Completion. After date of Substantial Completion has been determined revise the Contractor's Warranty Letter to include that date as start of Warranty period.
  4. Obtain and submit releases permitting the Authority unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  5. Prepare and submit Project Record Documents and similar final record information.
  6. Prepare and submit proof that specified testing and code inspections have been completed, accepted and certified, including, but not limited to, structural work, sprinkler piping systems, fire alarm and FPS systems, bacteriological testing of domestic lines, back-flow prevention, electrical system testing.
  7. Complete startup testing of systems.
  8. Submit test/adjust/balance records.
  9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  10. Advise the Authority of changeover in utilities.
  11. Submit changeover information related to the Authority's occupancy, use, operation, and maintenance.
  12. Complete final cleaning requirements, including touchup painting.
  13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- C. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, COTR will either proceed with inspection or notify Contractor of unfulfilled requirements. COTR 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 COTR, that must be completed or corrected before certificate will be issued.
1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Punch list work must be completed within the duration specified in Section III, "Schedule." Failure to complete the punch list work within the duration specified may result in the Contracting Officer ordering the work to be completed by others at the cost to Contractor.
  3. Results of completed inspection will form the basis of requirements for Final Acceptance.

#### 1.4 FINAL COMPLETION AND ACCEPTANCE

- A. Definition: "Final Completion" is the stage in the Contract when the Contracting Officer determines that all Work has been 100 percent completed according to the terms and conditions of the Contract Documents, including administrative obligations. The date of Final Acceptance is the date of execution by the Contracting Officer of a Certificate of Final Acceptance.
- B. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Application for Payment."
2. Submit certified copy of COTR's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by COTR. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit a Contractor/COTR joint statement evidencing that all Record Documents, Operation and Maintenance Manuals, warranties, and similar required submittals have been approved.
4. Complete demobilization and removal of temporary facilities from the site including construction equipment and facilities, mockups, and other similar elements. Restore areas to previously existing condition, if applicable.
5. Execute final Contract Modification and submit final Subcontractor Payment Form.
6. Return all AOA badging and all Authority Ids.
7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
8. Submit Record Schedule.
9. Submit warranty documentation.

C. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, COTR will either proceed with inspection or notify Contractor of unfulfilled requirements. COTR 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. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit four copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order.
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. Contract name and number.
  - b. Date.
  - c. Name of COTR.
  - d. Name of Architect/Engineer.
  - e. Name of Contractor.
  - f. Page number.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

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

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with Authority requirements, local laws and ordinances and Federal and local environmental and antipollution regulations. General cleaning during construction is included in Division 01 Section "Execution."
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - b. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - c. 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.
    - d. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - e. Sweep concrete floors broom clean in unoccupied spaces.
    - f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    - g. 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.
    - h. Remove labels that are not permanent.
    - i. 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.
  - j. Wipe surfaces of mechanical and electrical equipment, [elevator equipment,] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - k. Replace parts subject to unusual operating conditions.
  - l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - m. Replace disposable air filters and clean permanent air filters if construction was deemed to have dirtied them. Clean exposed surfaces of diffusers, registers, and grills.
  - n. Clean ducts, blowers, and coils if units were operated without filters during construction.
  - o. 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 high intensity discharge fixtures to comply with requirements for new fixtures.
  - p. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Authority's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.
1. Where extra materials of value remaining after completion of associated Work have become the Authority's property, arrange for disposition of these materials as directed by COTR.

END OF SECTION 017700

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## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications
3. Record Product Data.
4. Record Samples.
5. Record Schedule.
6. Miscellaneous Record Submittals.

- B. Related Sections include the following:

1. Division 01 Section "Construction Progress Documentation" for construction schedules as basis for Record Schedule.
2. Division 01 Section "Quality Requirements" for ensuring the record drawings and specifications are kept current on a daily basis and marked to show deviations which have been made from the original Contract documents
3. Division 01 Section "Project Closeout " for general closeout procedures
4. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
5. Divisions 02 through 33 Sections for specific requirements for Project Record Documents of products in those Sections.

#### 1.3 SUBMITTALS

- A. Record Drawings: One set of complete, full sized marked up record drawings.
- B. Record Schedule: Submit three copies of Record Schedule.
- C. Miscellaneous Record Submittals: Submit miscellaneous Record Submittals as specified.

### PART 2 - PRODUCTS

## 2.1 RECORD DRAWINGS

- A. Record Prints: During construction, maintain one complete, full sized, set of blue- or black-line prints of the Drawings, applicable shop drawings, and coordination drawings for record purposes. These drawings shall be updated by the contractor. The mark-ups shall be preserved for the record
1. Maintenance of Drawings: Maintain the drawings in a clean, dry, legible condition. Keep drawings available during normal working hours for inspection by the COTR.
  2. Preparation: Routinely mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the mark-ups on the record set.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later especially underground structures.
    - b. Record information in an understandable drawing technique. Ensure mark-ups are legible and reproducible.
    - c. Record data as soon as possible after obtaining it. Record and check markups before enclosing concealed installations.
  3. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations below first floor.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Notice and RFI.
    - k. Changes made following COTR's written orders.
    - l. Details not on the original Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  4. Mark the Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, insert them into drawing set and assign an appropriate sheet number (one that follows the number sequence of the contract drawings). Show cross-references to the new sheets on the Drawings. Update drawing index as needed to reflect new sheets.
  5. Mark record drawings with red pen that will reproduce clearly. Use different colors to distinguish between changes for different categories of the Work at the same location.
  6. Mark important additional information that was either shown schematically or not indicated on the original Drawings.
  7. Note applicable Construction Change Notices, Requests for Information, Technical Support Requests, and similar identification numbers, where applicable. Copies of

change documentation shall be inserted into the set for clarification but are not a substitute for mark-ups. If identification numbers for documentation are marked on the drawing when no change resulted, indicate "No Change".

B. Newly Prepared Project Record Drawing Sheets: The contractor may add new sheets with supporting sketches and change documentation instead of marking original sheets when neither the original Drawings nor Shop Drawings are suitable to show actual installation or if the new sheets can show the changes more clearly or additional space is required for markup information.

1. Assign a number to each new sheet and cross-reference on the appropriate related sheets.
2. Consult with COTR for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction.
3. Integrate newly prepared sheets into Record Drawing sets and update drawing index to reflect new sheets.

C. Format:

1. Identify and date each Record Drawing. Include the designation "PROJECT RECORD DRAWING" in a prominent location on each sheet.
2. Cover Sheet shall have the designation "PROJECT RECORD DRAWINGS", Date, Name of Contractor, and signature.

D. ADDITIONAL REQUIREMENTS FOR RECORD DRAWINGS

1. When there are multiple copies of the same sheet with different mark-ups on each copy, the General Contractor is responsible for consolidating all mark-ups onto a single copy of each individual sheet.
2. The information from all RFI's, Change Notices, Design Clarifications, field adjustments, or any other changes, must be noted on the appropriate drawing. These mark-ups must include enough information to clearly show the actual constructed conditions resulting from the change. The information may be drawn onto the drawing, copied onto the drawing or copied onto a new full size sheet. Every change in construction must have RFI's, Change Orders or similar supplementary documents; therefore they must be copied in original size and attached to the back of the preceding drawing or at the end of the drawing set, as an appendix, as a full size sheet, same in size as the drawing set. Multiple RFI's, CN's and other supplemental documents may be copied in each single sheet.
3. All changes made on the drawings shall reference the appropriate RFI, Change Notices, Design Clarification, or details from the contractor prepared shop drawings. If the mark-up is due to a field adjustment, it shall be indicated as such.
4. Additional Sheets such as shop drawings and sheets showing copies of applicable change documentation must be inserted into the set as necessary. Such sheets shall have a title block.
5. Notes and sketches printed by hand are acceptable but shall be neat, legible, and reproducible. Hand lettering shall be 3/8" high minimum.
6. All shop drawings showing information not on the construction drawings (with the exception of concrete embedded steel reinforcement bending drawings and steel reaction and fabrication drawings) shall be marked up and included in the record drawing set.

They shall be the same size (changes in scale noted) as all other drawings, include a title block, and clearly indicate that they are record shop drawings. When the shop drawings more accurately show locations and conditions, they may be marked in lieu of referenced on the original drawings. This does not relieve the contractor from the shop drawing inclusion requirements in the Operation and Maintenance Manuals that are a separate item

7. Include contract required coordination drawings in the record drawing set.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications. Print marked specifications, addenda, and contract modifications on paper any color but white and ensure that black font is clearly legible on the color chosen. Use the same paper color throughout the project. Use black font for these changes.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the brand name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of the manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
  5. Note related Change Orders, Record Drawings, and Product Data where applicable.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders, Record Drawings, and Product Data where applicable.
  4. Upon completion of mark-up, submit a complete set of record Product Data to COTR for the Authority's records.
  5. Where Record Product Data is required as part of maintenance manuals, submit marked-up product data as an insert in the manual.

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file

miscellaneous records and identify each, ready for continued use and reference. Submit to COTR.

1. Categories of requirements resulting in miscellaneous records include, but are not limited to the following:
  - a. Inspections and certifications by governing authorities.
  - b. Leakage and water-penetration tests.
  - c. Final inspections of all trades.
  - d. Certificates for piping for fire protection systems and FPS supervisory systems.

### PART 3 - EXECUTION

#### 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Repair or reproduce torn or dirty sheets. Provide access to Project Record Documents for COTR's reference during normal working hours.

END OF SECTION 017839

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## **TECHNICAL SPECIFICATIONS**

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## SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Demolition and removal of selected portions of building or structure.
  - 2. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for restrictions on the use of the premises, Authority-occupancy requirements, and phasing requirements.
  - 2. Section 017300 "Execution" for cutting and patching procedures.

#### 1.3 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 Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Authority.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

#### 1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor and shall be removed from Airport Property.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Authority that may be uncovered during demolition remain the property of Authority.

1. Coordinate with the Authority’s Archaeologist and Historic Preservation Coordinator, who will establish special procedures for removal and salvage.
- C. Archeological and Historical Findings: For additional requirements, see “Supplementary Conditions”

#### 1.5 SUBMITTALS

- A. Qualification Data: For demolition firm and refrigerant recovery technician.
- B. Schedule of Selective Demolition Activities: Indicate the following:
  1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Authority’s and other tenants' on-site operations are uninterrupted.
  2. Interruption of utility services. Indicate how long utility services will be interrupted.
  3. Coordination for shutoff, capping, and continuation of utility services.
  4. Use of elevator and stairs.
  5. Locations of proposed dust and noise control temporary partitions and means of egress, including for other tenants affected by selective demolition operations.
  6. Coordination of Authority’s and the Authority’s tenants partial occupancy of completed work.
  7. Means of protection for items to remain and the items in the path of waste removal from building.
- C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.
- D. Predemolition Photographs: Show existing conditions of adjoining construction improvements; include finish surfaces that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 Section “ Photographic Documentation” before work begins.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- F. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.
- G. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

#### 1.6 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. Professional Engineer Qualifications: Comply with Division 1 Section “Quality Requirements.”
- D. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- E. Standards: Comply with ANSI A10.6, NFPA 241 and the UBC.
- F. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section “Project Management and Coordination”. Review methods and procedures related to selective demolition including, but not limited to, the following:
  - 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure and evaluate structural safety/
  - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to makes progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  - 5. Review areas where existing construction is to remain and requires protection.

## 1.7 PROJECT CONDITIONS

- A. Authority and tenants will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Authority’s operations will not be disrupted. Provide not less than 72 hours’ notice to COTR of activities that will affect the Authority’s operations.
- B. Maintain access to existing walkways, corridors, or other adjacent occupied or used facilities.
  - 1. Do not close or obstruct walkways, corridors or other adjacent occupied or used facilities without written permission from COTR.
- C. The Authority assumes no responsibility for condition of areas to be selectively demolished.
  - 1. The Authority as far as practical will maintain conditions existing at time of inspection for proposal purposes.
- D. Hazardous Materials: For additional information regarding hazardous materials refer to Section “Supplementary Conditions”. In addition coordinate with the Authority’s Building codes/Environmental Department through the Authority Project Manager.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

## 1.8 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. Notify warrantor before proceeding.

## 1.9 DAMAGES AND PRE-EXISTING CONDITIONS

- A. For additional requirements regarding damages and pre-existing conditions, see “Supplementary Conditions”

## PART 2 - PRODUCTS

### 2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
  - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
  - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installation requirements specified in individual Specification Sections.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. 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 COTR.
- E. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
  - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
  - 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.
- G. 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 to Remain: Maintain services/systems indicated to remain and protect them against damage.
  - 1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. COTR will arrange to shut off indicated services/systems when requested by Contractor. For additional information concerning utility outages refer to "Supplementary Conditions".
  - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 3. 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. Remove conductors back to source of supply.
    - a. Where entire wall is to be removed, existing services/systems may be removed with removal of 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.
  - 1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- 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. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 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 as designed by Contractor's professional Engineer.

### 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. Obtain written approval from COTR before use of open flame. Obtain a welding/cutting permit from the Code Enforcement Division of Metropolitan Washington Airports Authority Fire and Rescue Department before use of open flame.
  6. Maintain adequate ventilation when using cutting torches.
  7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  10. Dispose of demolished items and materials promptly.



11. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- B. Existing Facilities: Comply with the Authority's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- C. Removed and Salvaged Items:
  1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Authority.
  4. Transport items to Authority's storage area as designated by COTR.
  5. Protect items from damage during transport and storage.
  6. If items are lost or damaged, they shall be replaced at Contractor's expense.
- D. Removed and Reinstalled Items:
  1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by COTR, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- 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. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI –WP and its Addenda.
  1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

### 3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Authority'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.
  - 4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

### 3.7 CLEANING

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

END OF SECTION 024119

## SECTION 057000 - DECORATIVE METAL

### 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. Stainless steel-clad steel-framed interior glazed partition walls.
2. Stainless steel glazing accessories for above, including stops, angles, fasteners, etc).
3. Stainless steel column covers.
4. Stainless steel tubes at column covers and at walls, to serve as bumper rail.
5. Stainless steel base.
6. Stainless steel panels associated with architectural woodwork.
7. Stainless steel corner guards for walls.
8. Stainless steel trim.
9. Stainless steel threshold.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for non-decorative metal fabrications.
2. Section 061053 "Miscellaneous Rough Carpentry."
3. Section 064023 "Interior Architectural Woodwork."

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass steel-framed interior glazed partition walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Components and connections shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  1. All steel framing components for interior glazed partition walls:
    - a. Uniform load of **50 lbf/ ft.** applied in any direction.
    - b. Concentrated load of **200 lbf** applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative metal.
  - 1. Include plans, elevations, component details, and attachments to other work.
  - 2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Samples for Verification: For each type of exposed finish required.
  - 1. Sections of linear shapes, 12” long.
  - 2. Sheet and Plate: 12”x12”
- E. Qualification Data: For fabricator.
- F. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- G. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.6, "Structural Welding Code - Stainless Steel."
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockups for the following types of decorative metal:
    - a. Stainless steel-clad steel-framed interior glazed partition walls: One complete full-height-and full-width panel from mullion to mullion, including glazing
    - b. Column Cover: each complete full-size column cover, for elliptical column cover and for round column cover, in locations acceptable to COTR. Include the following:
      - 1) Impact-resistant plastic laminate-clad panel, and/or stainless steel panel, as applicable to column cover typ
      - 2) Bumper rail.

- c. Provide stainless steel trim and panels for incorporation into other work as specified in that work's respective section.
  - 2. Approval of mockups does not constitute approval of deviations from Contract Documents contained in mockups unless COTR specifically approves such deviations in writing.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- B. Deliver and store cast-metal products in wooden crates surrounded by sufficient packing material to ensure that products will not be cracked or otherwise damaged.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.8 COORDINATION

- A. Coordinate installation of anchorages for decorative metal items. 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.

### PART 2 - PRODUCTS

#### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

#### 2.2 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 304.
- B. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.

- C. Bars and Shapes: ASTM A 276, Type 304.

## 2.3 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless exposed fasteners are unavoidable. Counter-sink where possible.
- D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

## 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

## 2.5 FABRICATION, GENERAL

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- D. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.
- E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- F. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

- G. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- H. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.
- I. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.
- J. Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

## 2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## 2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
- C. Exposed surfaces: Mirror like Reflective, Nondirectional Polish: No. 8.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.
- F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
  - 1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.
- G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication, General" Article. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
- H. Field Brazing: Comply with requirements for brazing and for finishing brazed connections in "Fabrication, General" Article. Braze connections that are not to be left as exposed joints but cannot be shop brazed because of shipping size limitations.
- I. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

### 3.3 INSTALLING METAL REVEALS AT WOOD PANELING

- A. Install metal reveals between wood panels as paneling is installed. Secure to wood grounds with specified screws.



### 3.4 CLEANING AND PROTECTION

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
- B. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057000

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## SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Wood blocking and nailers.
  - 2. Wood furring
- B. Related Requirements:
  - 1. Section 064023 – “Interior Architectural Woodwork”

#### 1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
  - 2. NHLA: National Hardwood Lumber Association.
  - 3. NLGA: National Lumber Grades Authority.
  - 4. SPIB: The Southern Pine Inspection Bureau.
  - 5. WCLIB: West Coast Lumber Inspection Bureau.
  - 6. WWPA: Western Wood Products Association.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Certified Wood: Lumber and plywood shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 3. Provide dressed lumber, S4S, unless otherwise indicated.

### 2.2 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
- B. For items of dimension lumber size, provide Construction or No. 2 of any species
  - 1. Maximum moisture content of 19 percent
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## 2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Metal Framing: ASTM C 954, length as recommended by screw manufacturer for material being fastened.
- F. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

## 2.4 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
  - 1. Adhesives shall have a VOC content of
  - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

### 3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

## SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Composite Panel Cladding
  - 2. Metal-wrapped plywood panel
- B. Related Sections include the following:
  - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

#### 1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including impact-resistant paneling, high-pressure decorative laminate, hardware and finishing materials and processes.
  - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings for Composite Panel Cladding system: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show details full size.
  - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 3. Show locations and sizes of cutouts and holes in architectural woodwork.
  - 4. Show location, configuration, and profile of all metal trim items.

- C. Samples for Initial Selection:
  - 1. Shop-applied opaque finishes.
  - 2. Plastic laminates.
  - 3. Edge material.
- D. Samples for Verification:
  - 1. Plastic laminates, 8 by 10 inches for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
  - 2. Framing and trim components of Composite Panel Cladding System.
- E. Qualification Data: For Installer and fabricator.
- F. Product Certificates: For each type of product, signed by product manufacturer.
- G. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
  - 1. Provide AWI Quality Certification Program certificates indicating that woodwork including installation complies with requirements of grades specified.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.



## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity at occupancy levels during the remainder of the construction period.
- C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
  - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Products: Comply with the following:
  - 1. Hardboard: AHA A135.4.
  - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
  - 3. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
- C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
  - 1. Basis of Design:
    - a. ColorCore2 by Formica Corporation

- 1) Pumice 858, Matte.

## 2.2 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Adhesives shall not contain urea formaldehyde.

## 2.3 FABRICATION, GENERAL

- A. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
- B. Complete fabrication, including assembly finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
  2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

## 2.4 COMPOSITE PANEL CLADDING

- A. Modular wall cladding system including HPDL panels and framing system, reveals, fasteners, closures, terminations, etc.
  1. Finished installation to match existing
  2. Basis of Design:
    - a. Transitions, by Environmental Interiors, Inc.

## 2.5 METAL-WRAPPED PLYWOOD PANELS

- A. Painted steel panels laminated onto plywood as indicated on drawings. Provide concealed clips, and framing as required.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing, architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

### 3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Anchor paneling to supporting substrate with panel manufacturers extruded aluminum rail and spline system. Do not use face fastening
  - 1. Install paneling with no more than 1/16 inch in 96 inch vertical cup or bow and 1/8 inch in 96 inch horizontal variation from a true plane.
- D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- E. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Touch up finishing work specified in this Section after installation of woodwork

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

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## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Latex joint sealants.
  - 2. Acoustical Sealants
- B. Related Sections:
  - 1. Section 088000 "Glazing" for glazing sealants.
  - 2. Section 092900 "Gypsum Board" for sealing perimeter joints.

#### 1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each kind 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.
- C. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. Field-Adhesion Test Reports: For each sealant application tested.

F. Warranties: Sample of special warranties.

#### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

#### 1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are greater or less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

#### 1.7 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Architectural Sealants: 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
  - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

## 2.2 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BASF Building Systems; Sonolac.
    - b. Pecora Corporation; AC-20+.
    - c. Tremco Incorporated; Tremflex 834.
  - 2. Colors: Custom colors as selected by COTR; may vary by location.
  - 3. Locations:
    - a. Interior joints other than those pertaining to the ceiling system.

## 2.3 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pecora Corporation; AC-20 FTR or AIS-919.
    - b. USG Corporation; SHEETROCK Acoustical Sealant.
  - 2. Locations: perimeter of ACP ceiling system.

## 2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.



## 2.5 MISCELLANEOUS MATERIALS

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

- a. Metal.
  - b. Glass.
  - c. Porcelain enamel.
  - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
- 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

### 3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

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## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
  - 1. Section 081119 "Stainless-Steel Doors and Frames" for hollow-metal doors and frames manufactured from stainless steel.
  - 2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

#### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8

#### 1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches
2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 8 by 10 inches to demonstrate compliance with requirements for quality of materials and construction:
  - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
  - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

D. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

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

F. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurement before fabrication.

## 1.8 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and direction for installing anchorages. Deliver such items to project site in time for installation.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

### 2.2 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerance: Fabricate hollow metal work to tolerances indicated in SDI 117
- C. Hollow-Metal Doors:
  - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
  - 2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch

beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

- D. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  2. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  3. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches high.
      - 2) Four anchors per jamb from 60 to 90 inches high.
      - 3) Five anchors per jamb from 90 to 96 inches high.
    - b. Compression Type: Not less than two anchors in each frame.
    - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
  4. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
  5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
  6. Terminated Stops: Terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- E. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Locate hardware according to ANSI/SDI A250.8
  2. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  3. Comply with applicable requirements in SDI A250.6 and ANSI/ BHMA A156.115 for preparation of hollow-metal work for hardware.



## 2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Hollow-Metal Doors and Frames: NAAMM-HMMA 860. At locations indicated in the Door and Frame Schedule.
  - 1. Physical Performance: Level A according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches
    - c. Face: cold-rolled steel sheet, minimum thickness of 0.032 inch
    - d. Edge Construction: Continuously welded with no visible seam.
    - e. Core: Steel stiffened.
  - 3. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    - b. Construction: Full profile welded.
  - 4. Exposed Finish: Prime.

## 2.4 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  - 2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
  - 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
  - 1. 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.

## 2.5 STEEL FINISHES

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

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

### 3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80.
    - b. 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.
    - c. Install frames with removable stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
  4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
  5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
  6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
  8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch , measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch , measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
    - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch .
    - c. At Bottom of Door: 3/4 inch.
    - d. Between Door Face and Stop: 1/8 inch plus or minus 1/32 inch

### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

## SECTION 081119 - STAINLESS-STEEL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Stainless-steel, hollow-metal doors.
  - 2. Stainless-steel, hollow-metal frames.
- B. Related Sections:
  - 1. Section 081113 "Hollow Metal Doors"
  - 2. Section 087100 "Door Hardware"

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door design.
  - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.
  - 8. Details of moldings, removable stops, and glazing.
  - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Verification:
  - 1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches
  - 2. Doors: Include section of vertical-edge, top, and bottom construction; core construction; glazing and hinge and other applied hardware reinforcement.
  - 3. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

- D. Schedule: Provide a schedule of stainless-steel, hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with a door hardware schedule.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of stainless-steel, hollow-metal door and frame assembly.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain stainless-steel, hollow-metal work from single source from single manufacturer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
- B. Shipping Spreaders: Deliver welded frames with two removable spreader bars across bottom of frames, tack welded or mechanically attached to jambs and mullions.
- C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber.
  - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

#### 1.8 COORDINATION

- A. Coordinate installation of anchorages for stainless-steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

### 2.1 STAINLESS-STEEL DOORS

- A. Description: Stainless-steel doors, not less than 1-3/4 inches thick, of seamless, hollow-metal construction. Construct doors with smooth, flush surfaces without visible joints or seams on faces.
1. Face Sheets: Fabricate from .042 inch thick, stainless-steel sheet.
  2. Core Construction: Fabricate doors with core indicated.
    - a. Laminated Core: foam-plastic insulation fastened to face sheets with waterproof adhesive.
    - b. Fire-Rated Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
  3. Vertical Edges for Single-Acting Doors: Beveled 1/8 inch in 2 inches
  4. Moldings for Glazed Lites in Doors: 0.038-inch- thick stainless steel.
  5. Loose Stops for Glazed Lites in Doors: 0.038-inch- thick stainless steel.
  6. Top and Bottom Channels: Closed with continuous channels, 0.062-inch thick stainless steel.
    - a. Spot welded to both face sheets.
    - b. Securely fastened using adhesive.
  7. Hardware Reinforcement: Fabricate reinforcing plates from stainless steel according to “Fabrication” article below.
  8. Electrical Hardware Enclosures: Provide enclosures and junction boxes within doors for electrically operated door hardware, interconnected with UL-approved, 1/2-inch-diameter conduit and connectors.
    - a. Where indicated for installation of wiring, provide access plates to junction boxes, fabricate from same material and thickness as face sheet and fasten with at least four security fasteners spaced not more than 6 inches o.c.
- B. Performance: Level A, ANSI A250.4.
- C. Materials:
1. Stainless-Steel Sheet: ASTM A 666, austenitic stainless steel, Type 304.
  2. Steel Sheet: ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, Commercial Steel (CS), Type B.
  3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum or A60 metallic coating.
  4. Foam-Plastic Insulation: Manufacturer's standard polystyrene board insulation with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within door.
- D. Glazing: Comply with requirements in Division 08 Section “Glazing”.
- E. Stainless-Steel Finishes:

1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
2. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
3. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - a. Mirrorlike Reflective, Nondirectional Polish: No. 8.

## 2.2 STAINLESS-STEEL FRAMES

- A. General: Fabricate stainless-steel frames of construction indicated, with faces of corners mitered and contact edges closed tight.
1. Door Frames: Machine mitered and full welded.
    - a. Weld frames according to HMMA 820.
  2. Sidelight and Transom Frames: Machine mitered and full welded.
  3. Provide Open-Back frame where required for concealed closer.
  4. Door Frames for Openings 48 Inches Wide or Less: Fabricate from 0.053 inch thick, stainless-steel sheet.
  5. Door Frames for Openings More Than 48 Inches Wide: Fabricate from 0.078-inch-thick, stainless-steel sheet.
  6. Glazing Stops: Formed integral with stainless-steel frames, minimum 5/8 inch high, unless otherwise indicated.
  7. Loose Stops for Glazed Lites 0.038-inch- thick stainless steel.
  8. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 866 with reinforcing plates from stainless steel.
  9. Head Reinforcement: 0.109-inch- thick, stainless-steel channel or angle stiffener for openings widths more than 48 inches
  10. Jamb Anchors:
    - a. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.050-inch- thick stainless steel.
    - b. Compression Type for Slip-on Frames: Fabricate adjustable compression anchors from stainless steel.
  11. Floor Anchors: Not less than 0.078-inch thick stainless steel, and as follows:
    - a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
    - b. 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.
  12. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- wide uncoated steel.
- B. Performance: Level A, ANSI A250.4.
- C. Materials:
1. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 304.
- D. Finishes:



1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - a. Mirrorlike Reflective, Non-directional Polish: No. 8.

## 2.3 ACCESSORIES

- A. Glazing: Comply with requirements in Section 088000 "Glazing."
- B. Grout: Comply with ASTM C 476, with a slump of not more than 4 inches as measured according to ASTM C 143/C 143M.
- C. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- D. Mineral Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

## 2.4 FABRICATION

- A. Stainless-Steel Door Fabrication: Stainless-steel doors to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.
  1. Seamed Edge Construction: Both vertical door edges joined by visible, continuous interlocking seam (lock seam) full height of door.
  2. Seamed Edge Construction: Both vertical door edges joined by visible seam that is projection, spot, or tack welded on inside edges of door at minimum 6 inches o.c.
  3. Seamless Edge Construction: Door face sheets joined at vertical edges by continuous weld extending full height of door; with edges ground and polished, providing smooth, flush surfaces with no visible seams.
  4. Stops and Moldings: Factory cut openings in doors. Provide stops and moldings around glazed lites. Form corners of stops and moldings with butted or mitered hairline joints.
    - a. Glazed Lites: Provide fixed stops and moldings welded on secure side of door.
    - b. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
  5. Hardware Preparation: Factory prepare stainless-steel doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."
    - a. Reinforce doors to receive non-templated mortised and surface-mounted door hardware.
  6. Locate hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

7. Tolerances: Fabricate doors to tolerances indicated in ANSI/NAAMM-HMMA 866.
- B. Stainless-Steel Frame Fabrication: Fabricate stainless-steel frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
  1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
  2. Provide countersunk, flat-, or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  4. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Four anchors per jamb from 60 to 90 inches (in height).
      - 2) Five anchors per jamb from 90 to 96 inches in height.
      - 3) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
    - b. Compression Type: Not less than two anchors in each jamb.
    - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
  5. Head Reinforcement: For frames more than 48 inches wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
  6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
  7. Stops and Moldings: Provide stops and moldings around glazed lites. Form corners of stops and moldings with butted or mitered hairline joints.
    - a. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
    - b. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
  8. Hardware Preparation: Factory prepare stainless-steel frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."

- a. Reinforce frames to receive non-templated mortised and surface-mounted door hardware.
  - b. Locate hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
9. Plaster Guards: Weld guards to frame at back of hardware mortises and mounting holes in frames to be grouted.
  10. Tolerances: Fabricate frames to tolerances indicated in ANSI/NAAMM-HMMA 866.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stainless-steel doors and frames.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of stainless-steel, door-frame connections before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace stainless-steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
  1. Squareness: Plus or minus 1/16 inch measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  2. Alignment: Plus or minus 1/16 inch measured at jambs on a horizontal line parallel to plane of wall.
  3. Twist: Plus or minus 1/16 inch measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  4. Plumbness: Plus or minus 1/16 inch measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install stainless-steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with ANSI/NAAMM-HMMA 866 and manufacturer's written instructions.
  
- B. Stainless-Steel Frames: Install stainless-steel frames of size and profile indicated.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-protection-rated openings, install frames according to NFPA 80.
    - b. Where frames are fabricated in sections due to 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.
    - c. Install frames with removable glazing stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g. Apply corrosion-resistant coating to backs of grout-filled frames.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors, if so indicated and approved on Shop Drawings.
  - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
  - 4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 5. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 6. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, 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 above. Provide adjustable wedged or bolted anchorage to frame jamb members.
  - 7. Installation Tolerances: Adjust stainless-steel frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch , measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

- d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Stainless-Steel Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
  - 1. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
  - 2. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
  - 3. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
  - 4. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
- D. Glazing: Install glazing in sidelights, transoms, and borrowed lights to comply with installation requirements in Section 088000 "Glazing."
  - 1. Secure stops with countersunk, flat-, or oval-head machine screws spaced uniformly not more than 9 inches o.c., and not more than 2 inches o.c. from each corner.

### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work including stainless-steel doors or frames that are warped, bowed, or otherwise unacceptable.
- B. Clean grout and other bonding material off stainless-steel doors and frames immediately after installation.
- C. Stainless-Steel Touchup: Immediately after erection, smooth any abraded areas of stainless steel and polish to match undamaged finish.

END OF SECTION 081119

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## SECTION 087100 - DOOR HARDWARE

### 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. Mechanical door hardware for the following:
    - a. Swinging doors.
- B. Related Sections:
  - 1. Section 081113 "Hollow Metal Doors and Frames
  - 2. Section 081119 "Stainless-Steel Doors and Frames"

#### 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 101, Life Safety Code
  - 3. American National Standards Institute (ANSI):
    - a. A156.6, Architectural Door Trim
    - b. A156.18, Materials and Finishes
  - 4. Door and Hardware institute (DHI)
    - a. Keying Systems and Terminology.
    - b. Recommended Locations for Builders Hardware for Custom Steel Doors and Frames.
  - 5. Underwriters Laboratories, Inc.: Building Materials directory

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Details of electrified door hardware, indicating the following:
  - 1. Wiring Diagrams: For power, signal, and control wiring and including the following:

- a. Details of interface of electrified door hardware and building safety and security systems.
  - b. Schematic diagram of systems that interface with electrified door hardware.
  - c. Point-to-point wiring.
  - d. Risers.
  - e. Elevations doors controlled by electrified door hardware.
2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
- C. Samples for Initial Selection: For plastic protective trim units in each finish, color, and texture required for each type of trim unit indicated.
- D. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.
1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch long Samples for other products.
    - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
  2. If requested by the COTR, submit one sample of each type of hardware tagged with full description for coordination with the schedule. These items shall remain on file in the COTR's office until all other similar items have been installed in the project. At that time, items on file will be turned over to the Airport Authority for Maintenance Stock.
- E. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
- a. Submittal Sequence: Submit door hardware schedule after or concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
  - b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
  - c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
  - d. Content: Include the following information:
    - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
    - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.



- 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
  - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
  - 5) Fastenings and other pertinent information.
  - 6) Explanation of abbreviations, symbols, and codes contained in schedule.
  - 7) Mounting locations for door hardware.
  - 8) List of related door devices specified in other Sections for each door and frame.
- e. Schedules not adhering to these parameters will not be reviewed.
- F. Keying Schedule: After Hardware Schedule has received COPR's approval, submit a separate keying schedule, prepared by or under the supervision of the Architectural Hardware Consultant, indicating the Airports Authority's approved master key system with final submittal of schedule. Include schematic keying diagram and index each key set to unique door designations.
- G. Operating Instructions: Furnish the Airport Authority with one complete set of installation instructions, including special adjusting tools and maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Furnish information in Compact Disk form, one for each applicable manufacturer, as well as internet web sites for each manufacturer.
1. One condensed catalog shall be furnished for each manufacturer listed in the approved hardware schedule.
- H. Templates: provide necessary templates and/or physical hardware to all trades or manufacturers 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 such hardware via pre-paid freight in sufficient time to prevent any delay in the execution of their work.
- I. Qualification Data: For Installer and Architectural Hardware Consultant.
- J. Product Certificates: For electrified door hardware, from the manufacturer.
1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- K. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- L. Warranty: Special warranty specified in this Section.
- 1.5 QUALITY ASSURANCE
- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
  2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
  3. Engineering Responsibility: Preparation of 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.
- B. Source Limitations: Obtain each type of door hardware from a single manufacturer.
1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- D. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch of water.
- E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- F. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- G. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines ICC/ANSI A117.1
1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf
  2. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
    - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch
  4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- H. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to COTR, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware

Consultant and Authority's security consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2. Preliminary key system schematic diagram.
3. Requirements for key control system.
4. Requirements for access control.
5. Address for delivery of keys.

I. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver door hardware to the Contractor. Direct factory shipments (drop shipments) to the job site are not acceptable.

1.7 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail 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 doors and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
    - a. Electromagnetic Locks: Five years from date of Substantial Completion.
    - b. Exit Devices: Two years from date of Substantial Completion.
    - c. Manual Closers: 10 years from date of Substantial Completion.

## 1.9 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide twelve months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products or products equivalent in function and comparable in quality to named products, complying with BHMA designations referenced.
  2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

## 2.2 HARDWARE ITEMS

- A. Hinges: Bommer Industries, Hager Hinge, McKinney Manufacturing or Stanley Works.
  1. Furnish two hinges for doors 60-inches or less in height and one additional hinge for each additional 30-inches of height or fraction thereof.
    - a. Unless otherwise specified, hinges for doors though 36-inches wide shall be 4.5 x4.5. Hinges for doors over 36-inches wide shall be heavyweight 5 x 4.5.
    - b. Hinges for labeled doors shall comply with the requirements of NFPA 80.
  2. All hinges shall be five-knuckle type. Furnish non-removable pins (NRP) for all reverse bevel doors receiving keyed locks, rigid outside trim or "exit only" hardware. All hinges shall have holes in the bottom plug to facilitate pin removal.
  3. Hinges with anti-friction bearings may be furnished in lieu of ball bearing hinges, except where prohibited on fire doors by the requirements of NFPA 80.
- B. Continuous Hinges: Hager Companies, Markar Products or Stanley Works.
  1. Refer to the Schedule of Groups for grade, type and style.
    - a. Barrel Type: 14-gauge stainless steel with nylon bearings and stainless steel pins.
- C. Cylinders: Best Access Systems.
  1. Cylinders shall be 7-pin, interchangeable core type with cores removable by special control key. Equip all cylinders with temporary, color-coded construction cores for use during construction.
  2. Cylinders shall be furnished complete with collars and cams required and fitted without adapters
- D. Locks and Latches: Best Access Systems.
  1. Levers shall be cast or solid metal. All internal working parts shall be brass, bronze, steel or stainless steel.
  2. For each lock and latchset, provide strike box and square corner ASA strike with curved lips of sufficient length to protect frames.
  3. Locks and latches shall be Best 4514 Series with 15H trim.
- E. Exit Devices: Precision Hardware, Sargent or Von Duprin.
  1. Where lever handle functions are required on exit devices, they shall match the design of lever handles specified for other locks and latches.
  2. Furnish wrought steel mortar guards with all strikes.
  3. Furnish keyed devices less cylinders; provide cylinders keyed to building system. All key operated exit devices shall be prepared to accept Best 7-pin interchangeable core cylinders.
- F. Surface Closers: LCN Closers, Norton Door Controls or Sargent.
  1. Surface closets shall be LCN 4041 Series or Norton 7500 Series or Sargent 281 Series, with full cover. Closer arms shall be forged and fluid shall accommodate all applicable weather conditions.

- a. Where parallel arm closers are required, furnish manufacturer's extra-heavy duty arm.
  2. Where factory sized closers are specified, sizes are to be determined by manufacturer's recommendations for door size, location and applicable handicap requirements.
  3. Locate surface closers on the least conspicuous side of the door (side opposite public view).
- G. Concealed Closers: Dorma Architectural Hardware or LCN Closers.
1. 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.
  2. Where factory sized concealed closers are specified, sizes are to be determined by manufacturer's recommendations for door size, location and applicable accessibility requirements.
  3. Furnish for 180-degree door opening where partition construction will permit.
- H. Architectural Door Trim: Burns, Builders Brass Works, Hager Companies, Rockwood or Trimco.
1. Kick and armor plates shall be beveled on all sides, equal to Hager 194S Series.
    - a. Unless otherwise indicated, or where narrow bottom rails dictate a smaller size, kick plates shall be 10-inches high and armor plates 48-inches high (16-inches high on fire labeled doors). Width 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.
    - b. Except where narrow stiles dictate a smaller size, push and pull plates shall be 6 inches by 16 inches.
  2. Factory-prepare flat goods for conflicting hardware (e.g. lever handles, cylinders, turn pieces, etc.) as required.
- I. Auxiliary Hardware: Builders Brass Works, Hager Companies, Ives, Rockwood or Trimco.
1. Manual Flush Bolts: Top manual flush bolts shall not exceed 74-inches from floor to centerline.
  2. Stops: Provide wall stops equal to Rockwood 400 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. Silencers are not required at doors specified to receive continuous weather-stripping or seals.
- J. Automatic Flush Bolts and Coordinators: Door Controls International, Hager Companies, Ives or Rockwood.
1. Coordinators shall be continuous across door header, complete with filler plates and closer brackets as required. Furnish coordinators primed for field painting.
    - a. Provide standard strikes with wrought boxes for top bolts.
- K. Overhead Holders and Stops: Architectural Builders Hardware, Glynn-Johnson or Rixson.
1. Where floor stops will not work, furnish concealed overhead stops equal to Glynn Johnson 410S.
- L. Thresholds, Weather-stripping and Seals: Hager Companies, National Guard Products, Pernko, Reese Enterprises or Zero International.

1. Refer to the Schedule of Groups for grade and style. Where required, factory-prepare thresholds to receive strikes for exit devices and flush bolts.
  2. Fire-Rated Doors and Smoke Doors: At doors located in Fire-Rated partitions or Smoke Barrier Partitions, provide smoke seals equal to Pemko S88 at the head and jambs; and at pairs of doors, one Pemko 375CR or two Pemko 303AS astragal seals as appropriate. Refer to the Drawings for locations.
- M. Electric Strikes: Folger Adam or Von Duprin.
1. Electric strikes shall be cast iron construction of function indicated.
  2. Provide units at 24V DC operating current. Coordinate electrical connection and installation with Division 28.
- N. Delayed Egress Locks: Locknetics, Securitron Magnalock or Security Door Controls
1. Devices shall comply with all applicable provisions VUSBC.
  2. Description: Delayed egress locking system, incorporating electromagnetic lock with built-in triggering mechanism and mechanical key bypass/reset; allowing delayed exiting after pushing on door.
  3. Operation:
    - a. Applying 15-pounds or less pressure for three seconds or less to exit device with built-in “request to exit” switch triggers unlocking sequence and unit sends remote signal to security system. Audible alarm sounds. Fifteen seconds after pushing on door, unit releases to allow free egress. System automatically relocks after 45 seconds. System can be activated and de-activated by built-in key switch.
    - b. When delayed-egress system is activated, delayed-egress lock shall automatically disable alarm and unlock upon receipt of valid signal from access control system.
    - c. When delayed-egress system is activated, delayed egress lock shall automatically unlock upon activation of fire and heat/smoke alarm system. Coordinate with installation and operation of fire and heat/smoke alarm system.
    - d. When delayed-egress locks are installed on adjacent door leaves (e.g. pairs or banks of doors), devices shall be wired in sequence so that activation of one lock causes all devices in row to unlock.
    - e. Provide fail-safe application so that system unlocks in event of power failure.
  4. Furnish complete with sign mounted on door, with block capital letters 1 -inch in height, reading “PUSH UNTIL ALARM SOUNDS. DOOR CAN BE OPENED IN 15 SECONDS”.
    - a. Sign shall be located above and within 12-inches of the exit/actuation device.
  5. Coordinate electrical connection and installation with Division 28.
- O. Electric Power Transfers: LCN Closers or Von Duprin. )
1. Electric power transfers shall be fully concealed equal to Von Duprin EPT Series. Power transfers shall have minimum two 18-gauge wires; rating — 24VDC 2 amperes continuous and 16 amperes maximum surge.
- P. Magnetic Switches: GE Security (Sentrol).
1. Magnetic switches shall be reed type, double pole, double throw with three wires. Provide built-in, end of line resistors as required by the Electronic Security Control System.
  2. Locate magnetic switches in doors and frames per manufacturer’s recommendations.
  3. Coordinate electrical connection and installation with Division 28.

- Q. Special Tools: Provide any necessary special tools (e.g. spanner and socket wrenches, dogging keys, etc.) required to service and adjust hardware items.
- R. Compatibility with Existing Systems: All electrical hardware supplied shall be compatible with, and capable of connection to, existing Dulles International Airport access control and fire suppression systems.

## 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 applicable), 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 FSFF-H-1 1 C, as applicable.
  - 1. All exposed hardware except surface closers and hinges shall be satin stainless steel, ANSI/BHMA 6301US32D. Surface closers shall be painted to match satin stainless steel. Hinges on interior doors shall be satin chrome plated, ANSI/BHMA 626/US26D; hinges on exterior doors shall be satin stainless steel. Items of hardware not available in stainless steel shall be furnished with a satin chrome finish.
  - 2. Where painting of primed surfaces is required, refer to Division 09 specifications.

## 2.4 KEYING

- A. General: 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".
  - 1. All permanent cylinders shall be factory-keyed to the existing Best Access Systems master key system.
- B. Keys: Provide keys of nickel silver only. Furnish two cut keys per lock (stamped with the key change number), ten control keys (for removal of cores), 100 blanks and ten construction master keys.
  - 1. Process all requests for additional keys through the Airport Engineering and Maintenance Division.
    - a. The Authority's locksmith's services shall be charged to Contractor. These charges will be in accordance with Metropolitan Washington Airports Order and Instructions TAD 10-0-2C "Key Control at Washington Dulles International Airport".

## 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 are not acceptable.
  2. Furnish all flat goods with Phillips undercut, countersunk screws per ANSI/BHMA A156.6. Truss head screws are not acceptable.
- B. 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. Does not use through bolts for installation except where it is not possible to adequately reinforce the work, to accept machine screws or concealed fasteners or another standard type, to satisfactory avoid the use of through bolts. Grommet nuts and cealnuts are not acceptable.
- C. 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. A representative of the Contractor shall receive the hardware when delivered at the job site. 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.
- B. 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. Prior to ordering any hardware, the hardware supplier shall 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.

#### 3.3 INSTALLATION

- A. Mounting Heights: Mount hardware units at heights recommended by DI-II (see “Recommended Locations for Builder’s Hardware”) on custom doors except as otherwise

indicated or required to comply with governing regulations, and except as may be otherwise directed.

- B. Install each hardware item in strict compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in any other way, install each item completely and then remove and store in a secure place during the finish application. After completion of the finishes, re-install each item. Do not install surface mounted items until finishes have been completed on the substrate.
  - 1. Where shimming of hinges is required, use metal shims only.
- C. Set units level plumb and true to line and location. Adjust and reinforce substrate as necessary for proper installation and operation. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards. Cut and fit thresholds and Weather-stripping to profile of door frames, with mitered corners and hair line joints. Join units with concealed welds or concealed mechanical joints wherever possible. Cut smooth openings for spindles, cylinders, bolts and similar items. All mortises shall be smooth and tight. All drilling for tapping shall be done with proper sized drill bits to insure a minimum of 75% full thread
- D. 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

### 3.4 FIELD QUALITY CONTROL

- A. Contractor Supervision: Provide supervision for door hardware installation. Inspect door hardware for conformance with requirements. The Contractor shall notify the COTR at least 72 hours in advance of inspection so that appropriate representatives may attend.

### 3.5 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door to insure proper operation or function of every unit. 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.
- B. Final Adjustment: Wherever hardware has been 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 make 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.
- C. After the Airport Authority has occupied the spaces, Manufacturers' Representatives of closers, exit devices, locks, and other operating hardware as deemed necessary, shall visit the site and make adjustments to the equipment to ensure proper functioning. This inspection and adjustment shall be made after final adjustment of the heating and ventilating equipment.

- D. Instruct the Airport Authority's maintenance personnel in proper adjustment and maintenance of hardware and hardware finishes during the final adjustment of hardware. Verify that the Airport Authority has been supplied with manufacturers' installation and maintenance manuals, catalogs and any special adjusting tools normally supplied by the manufacturer.

3.6 HARDWARE SCHEDULE:

**Hardware Set #: 0001** - SGL DRS HMD & HMF  
D01

Opening to Have:

Qty Description	Finish	Mfg
3 HINGE CB168 4.5 x 4.5 x NRP	652	STANLEY
1 MORTISE CYLINDER [IC] 1E74 x C4 x RP3 x ABC x CORMAX	626	BEST
1 RIM CYLINDER [IC] 1E72 x RP x ABC x CORMAX	626	BEST
1 POWER TRANSFER PT1000	628	ABH
1 POWER SUPPLY ELR-151	600	PRECISION
1 RIM EXIT DEVICE E2103CD x FSE x V4908D x 24VDC	630	PRECISION
1 DOOR CLOSER 4111 x SPRING CUSH	689	LCN
1 KICK PLATE 16" x 2" LDW .050 B4E x CSK	630	BURNS
1 MOP PLATE 6" x 1" LDW .050 B4E x CSK	630	BURNS
1 EMERGENCY PULL STATION 492 x 2-SPDT x SIREN	BLUE	SDC
1 MAGNETIC SWITCH MC-7 x SPDT x 1" DIA		SDC
1 MAGNETIC LOCK 1511V x 12/24VDC	628	SDC
3 SILENCERS 500		GRAY BURNS
2 CARD READERS SPECIFIED ELSEWHERE		

**Hardware Set #: 0002** - PRS DRS SS-DRS & SS-FR  
D03

Opening to Have:

Qty Description	Finish	Mfg
6 HINGE CB199 4.5 x 4.5	630	STANLEY
2 PUSH / PULL BAR M422 x M36D x (2) T-1HD x (1) T-5HD	630	BURNS
2 DOOR CLOSER 4111 x SPRING-H-CUSH	689	LCN
2 MOUNTING PLATE 4110-18CNS	689	LCN

**Hardware Set #: 0003** - PRS DRS HMD & SS-FR  
D02 D02A

Opening to Have:

Qty Description	Finish	Mfg
2 CENTER HUNG PIVOT 0370	630	ABH
2 ARMOR PLATE 36" x 1" LDW .050 B4E x CSK	630	BURNS
2 AUTOMATIC OPERATORS SPECIFIED ELSEWHERE		

**Hardware Set #: 0004** - SGL DRS HMD (relocated) & HMF  
D06

Opening to Have:

Qty Description

Finish Mfg

All items existing to be relocated.

END OF SECTION 087100

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## SECTION 087113 - AUTOMATIC DOOR OPERATORS

### 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. Power door operators for swinging doors.
- B. Related Requirements:
  - 1. Section 081113 "Hollow Metal Doors"
  - 2. Section 087100 "Door Hardware"

#### 1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- C. Double-Egress (Doors): A pair of doors that simultaneously swing with the two doors moving in opposite directions with no mullion between them.
- D. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
- E. For automatic door terminology, see BHMA A156.10 and BHMA A156.19 for definitions of terms.

#### 1.4 COORDINATION

- A. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing automatic door operators.
- B. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.
- C. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to power supplies and access-control system.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For automatic door operators.
  - 1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
  - 2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Indicate locations of activation and safety devices.
  - 4. Include diagrams for power, signal, and control wiring.
  - 5. Include plans, elevations, sections, and attachment details for guide rails.
- C. Samples: For each exposed product and for each color and texture specified, manufacturer's standard size.
- D. Qualification Data: For Installer.
- E. Product Certificates: For each type of automatic door operator.
- F. Sample Warranties: For manufacturer's special warranties.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.
  - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Certified Inspector Qualifications: Certified by AAADM.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:



- a. Faulty or sporadic operation of automatic door operator, including controls.
  - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.
2. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide or comparable product by one of the following:
1. Besam Entrance Solutions; Subsidiary of ASSA ABLOY Entrance Systems.
  2. Door Motion Technologies, Inc.
  3. DORMA Architectural Hardware; Div. of DORMA Group North America.
  4. DORMA Automatics; Div. of DORMA Group North America.
  5. Horton Automatics; a division of Overhead Door Corporation.
  6. Hunter Automatics Inc.
  7. LCN Closers; an Ingersoll-Rand company.
  8. Nabco Entrances Inc.
  9. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
  10. Stanley Access Technologies, LLC; Div. of Stanley Security Solutions.
- B. Source Limitations: Obtain automatic door operators, including activation and safety devices, from same manufacturer as for hardware in Section 087100 "Door Hardware."

### 2.2 AUTOMATIC DOOR OPERATORS, GENERAL

- A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and according to UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
1. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to automatic door operator when door is in emergency breakaway position, to return door to closed position after breakaway, and to automatically reset.
  2. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
- B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.

## 2.3 POWER DOOR OPERATORS

- A. Standard: BHMA A156.10.
- B. Performance Requirements:
  - 1. Opening Force:
    - a. Power-Operated Swinging Doors: Not more than 30 lbf required to manually open door if power fails.
  - 2. Entrapment-Prevention Force: Not more than 40 lbf required to prevent stopped door in the last 10 degrees of opening from moving in the direction of opening; not more than 30 lbf required to prevent stopped door from moving in direction of closing.
- C. Configuration: Operator to control pair of swinging doors.
- D. Traffic Pattern: One way.
  - 1. Operator Mounting: Overhead concealed.
- E. Operation: Power opening and spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.10.
- F. Operating System: Electromechanical.
- G. Microprocessor Control Unit: Solid-state controller.
- H. Features:
  - 1. Adjustable opening and closing speed.
  - 2. Adjustable opening and closing force.
  - 3. Adjustable backcheck.
  - 4. Adjustable hold-open time from zero to 30 seconds.
  - 5. Adjustable time delay.
  - 6. Adjustable acceleration.
  - 7. Adjustable limit switch.
  - 8. Obstruction recycle.
  - 9. Automatic door re-open if stopped while closing.
  - 10. On-off/hold-open switch to control electric power to operator; key operated.
- I. Controls: Activation and safety devices according to BHMA standards.
  - 1. Activation Device: Motion sensor mounted on ingress side of door header to detect pedestrians in activating zone and to open door.
  - 2. Safety Device: Presence sensor mounted on door header guide rail to detect pedestrians in presence zone and to prevent door from closing.
- J. Exposed Finish: to match door hardware.

## 2.4 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - 1. Extrusions: ASTM B 221.
  - 2. Sheet: ASTM B 209.
- B. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

## 2.5 CONTROLS

- A. General: Provide controls, including activation and safety devices, according to BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.
- B. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed in plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10.
  - 1. Provide capability for switching between bidirectional and unidirectional detection.
  - 2. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.
- C. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

## 2.6 FABRICATION

- A. Factory fabricate automatic door operators to comply with indicated standards.
- B. Form aluminum shapes before finishing.
- C. Fabricate exterior components to drain condensation and water passing joints within operator enclosure to the exterior.
- D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.
- E. Provide metal cladding, completely covering visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.

## 2.7 ACCESSORIES

- A. Signage: As required by cited BHMA standard for type of door and its operation.

## 2.8 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
- B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.
- C. Examine roughing-in for compressed-air piping systems to verify actual locations of piping connections before automatic door operator installation.
- D. Verify that full-height finger guards are installed at each door with pivot hinges where door has a clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install automatic door operators according to manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.
  - 1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
  - 2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.
- B. Controls: Install activation and safety devices according to manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Access-Control System: Connect operators to access-control system as specified in Division 26.

- D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test and inspect each automatic door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.
- B. Automatic door operators will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.4 ADJUSTING

- A. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
- B. After completing installation of automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.
- C. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).
- D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of automatic door operator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
  - 2. Perform maintenance, including emergency callback service, during normal working hours.
  - 3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.6 DEMONSTRATION

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

END OF SECTION 087113

## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - 1. Doors.
  - 2. Stainless steel-clad steel-framed interior glazed partition walls.
- B. Related Sections:
  - 1. Section 057500 "Decorative Metal" for glass panels in Stainless steel-clad steel-framed interior glazed partition walls.
  - 2. Section 08119 "Stainless Steel Doors and Frames"

#### 1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation;; deterioration of glazing materials; or other defects in construction.
  - 1. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
  - 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch whichever is less.

## 1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

## 1.6 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass, 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Qualification Data: For installers.
- E. Product Certificates: For glass and glazing products, from manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for glass, glazing sealants, and glazing gaskets.
  - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- G. Preconstruction adhesion and compatibility test report.
- H. Warranties: Sample of special warranties.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- D. Safety Glazing: Comply with testing requirements in 16 CFR 1201.



1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to the authorities having jurisdiction.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Install glazing in mockups specified in Section 057000 "Decorative Metals" and as directed by COTR
  2. Approved mockups may become part of the completed Work.
- F. Preinstallation Conference: Conduct conference at Project site

#### 1.8 DELIVERY, STORAGE, AND HANDLING

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

#### 1.9 PROJECT CONDITIONS

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

#### 1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to the authority and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to the authority and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear).
- B. Transparent Mirror Glass:
  - 1. ASTM C 1036, Type I (transparent flat glass), Class 2 (tinted), Quality-Q3.
  - 2. Coating:
    - a. Manufacturer's standard scratch-resistant, semi-opaque coating, serving as a mirror on one side of glass while allowing unobserved viewing from the other side.
    - b. Coating shall be pyrolitically-deposited (hard coat). Sputter or vacuum-deposited (soft coat) coatings are not acceptable.
  - 3. Tint Color: Gray
    - a. Visible transmittance: 12 percent
    - b. Visible reflectance: 60 percent
  - 4. Thickness: 6mm.
  - 5. Available Products: subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pilkington; Mirrorplane TM Transparent Mirror.
- C. Laminated Glass: ASTM C 1172, and complying with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 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. DuPont Building innovations; SentryGlas Plus
  - 2. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
  - 3. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 4. Interlayer Color: Clear unless otherwise indicated.
  - 5. Physical properties:
    - a. Young's Modulus, when tested in accordance with ASTM D5026: 43 kpsi
    - b. Tensile strength, when tested in accordance with ASTM D638: 5.0 kpsi
    - c. Elongation, when tested in accordance with ASTM D638: 400 percent.
    - d. Flexural modulus, when tested in accordance with D790: 50 kpsi
    - e. Heat deflection temperature at 0.46 MPa when tested in accordance with D648: 110 deg F.

### 2.2 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
  - 1. Neoprene complying with ASTM C 864.
  - 2. EPDM complying with ASTM C 864.
  - 3. Silicone complying with ASTM C 1115.

4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM, silicone, or thermoplastic polyolefin rubber] gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

### 2.3 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

### 2.4 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
  - a. Dow Corning Corporation; 795
  - b. GE Advanced Materials - Silicones; SilPruf SCS2000.
  - c. Pecora Corporation; 864 or 890.
  - d. Tremco Incorporated; Spectrem 3.

## 2.5 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Grind smooth and polish exposed glass edges and corners.

## 2.6 LAMINATED-GLASS TYPES

- A. Glass Type GL-1: laminated vision glass one ply of clear float glass and one of mirror glass.
  1. Thickness of Each Glass Ply: 6.0 mm
  2. Interlayer Thickness: 0.030 inch
  3. Interlayer color: clear
  4. Provide safety glazing labeling.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

### 3.4 TAPE GLAZING

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

### 3.5 GASKET GLAZING (DRY)

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

### 3.6 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

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## SECTION 092216 - NON-STRUCTURAL METAL 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. Non-load-bearing steel framing systems for interior gypsum board assemblies.
  - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

#### 1.3 SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, G40 hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.
  - 1. Steel Studs and Runners:
    - a. Minimum Base-Metal Thickness: 0.036 inch (20 Gauge).
    - b. Depth: As indicated on Drawings
- C. Slip-Type Head Joints: Where indicated, provide the following:
  - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.

- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base-Metal Thickness: 0.036 inch (20 Gauge).
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base-Metal Thickness: 0.036 inch (20 Gauge).
  - 2. Depth: As indicated on Drawings.

## 2.2 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch diameter wire, or double strand of 0.048-inch diameter wire.
- B. Hanger Attachments to Concrete:
  - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
    - a. Type: Postinstalled, expansion anchor.
  - 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
    - a. Obtain written approval from COTR before bringing cartridge style nail guns and other tools that use a cartridge or any explosive charge on Project.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.
- F. Furring Channels (Furring Members):
  - 1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
  - 2. Steel Studs and Runners: ASTM C 645.
  - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
  - b. Chicago Metallic Corporation; Drywall Grid System.
  - c. USG Corporation; Drywall Suspension System.

### 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
  1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
  2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
- E. Direct Furring:
  - 1. Screw to wood framing.
  - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Hangers: 48 inches o.c.
  - 2. Carrying Channels (Main Runners): 48 inches o.c.
  - 3. Furring Channels (Furring Members): 16 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 5. Do not attach hangers to steel roof deck.
  - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.
- B. Related Requirements:
  - 1. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Low-Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

### 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. American Gypsum.
  2. CertainTeed Corp.
  3. Georgia-Pacific Gypsum LLC.
  4. Lafarge North America Inc.
  5. National Gypsum Company.
  6. PABCO Gypsum.
  7. Temple-Inland.
  8. USG Corporation.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
  1. Thickness: 5/8 inch
  2. Long Edges: Tapered.
- C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
  1. Thickness: 1/2 inch
  2. Long Edges: Tapered.



## 2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
  - 2. Shapes as indicated on drawings, including but not limited to:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - d. L-Bead: L-shaped; exposed long flange receives joint compound.
    - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
    - g. Curved-Edge Cornerbead: With notched or flexible flanges.

## 2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type compound.
  - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  - 4. Finish Coat: For third coat, use setting-type, sandable topping drying-type, all-purpose compound.
  - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

## 2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  2. Fit gypsum panels around ducts, pipes, and conduits.
  3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

#### A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically parallel to framing unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
  - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

- B. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

### 3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings.
- C. Interior Trim: Install in the following locations:
  1. Cornerbead: Use at outside corners unless otherwise indicated.
  2. LC-Bead: Use at exposed panel edges.
  3. L-Bead: Use where indicated.
  4. U-Bead: Use at exposed panel edges.

### 3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

- C. Apply joint tape over gypsum board joints, unless specifically indicated as not intended to receive tape.
- D. Apply joint tape over edges of interior trim, except for trim products specifically indicated as not intended to receive tape.
- E. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 5: At all finish surfaces exposed to view.

### 3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Related Requirements:
  - 1. Section 095123 "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.
- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
  - 1. Acoustical Panel: Samples of each type, color, pattern, and texture.
    - a. Type ACP-1: Full size pattern
    - b. Type ACP-2: 6 inch by 6 inch
  - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch long Samples of each type, finish, and color.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which suspension systems will be attached.
  - 3. Size and location of initial access modules for acoustical panels.
  - 4. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.

- D. Qualification Data: For testing agency.
- E. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.
- F. Evaluation Reports: For each acoustical panel ceiling suspension system.
- G. Maintenance Data: For finishes to include in maintenance manuals.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Panels: Full-size panels equal to 1 percent of quantity installed.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: obtain each type of acoustical ceiling panel and supporting system though one source from a single manufacturer.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of typical ceiling area as shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

## 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

## PART 2 - PRODUCTS

### 2.1 ACOUSTICAL PANELS, GENERAL

- A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
  - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.
- C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

### 2.2 ACOUSTICAL PANELS

- A. Acoustical Panel Type ACP-1:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Focus D, by Ecophon CertainTeed, inc.
  - 2. Description: Glass-fiber composite acoustical panels.
    - a. Core:
      - 1) 1" thick, 6 to 7 pcf fiberglass core; with glass cloth adhered to plenum side of panel.
      - 2) Edges: Coat edges with same acoustically-transparent coating used for face sheets.
    - b. Face sheet:

- 1) Coating Acoustical panel manufacturer's nonbriding acoustically-transparent coating. Shop-apply coating to panel face sheets, and also to panel perimeter edges.
  - 2) Coating color: Manufacturer's standard flat white.
  3. Modular Size: 24 inch x24 inch
  4. Edge profile: Rabbeted and beveled edge, sized to fit flange of 15/16 inch wide concealed suspension system framing members.
  5. Light reflectance (LR): ASTM E1477, not less than LR .80
  6. Flame spread: ASTM E1264, 0-25.
  7. Absorption class: EN ISO 11654, Class A.
- B. Acoustical Panel Type ACP-2:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Tundra 304 by Armstrong World Industries, Inc.
  2. Description: Mineral fiber with non-directional medium texture.
  3. Classification, per ASTM E1264: Type III, mineral base with painted finish; Form 2, water felted; Pattern CE (perforated, small holes and lightly textured).
  4. Modular size: 24 inch x 24 inch by 3/4 inch thick.
  5. Edge profile: Beveled reveal (tegular) lay-in, sized to fit flange of 9/16 inch wide exposed suspension system members.
  6. Finish: Factory applied washable vinyl latex paint.
  7. Color: white.
  8. Light reflectance (LR): ASTM E1477, not less than LR .80.
  9. Flame spread: ASTM E1264, 0-25.
  10. Noise-reduction coefficient (NRC): ASTM E1264, not less than .50.
  11. Ceiling attenuation class (CAC Range): ASTM E1264, not less than 35.

## 2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: Postinstalled expansion anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.



2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
  - a. Obtain written approval from COTR before bringing cartridge style nail guns and other tools that use a cartridge or any explosive device, on Project.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
4. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch diameter wire.

## 2.4 METAL SUSPENSION SYSTEM

A. Concealed Suspension System: Type ACP-1 Panels:

1. Ceiling panel manufacturer's steel grid suspension system, compatible with rabbeted and beveled edge acoustical ceiling panels.
2. Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A653/A653M, not less than G30 coating designation, with prefinished 15/16-inch wide metal caps on flanges
  - a. Structural Classification: Intermediate-duty system.
  - b. End Condition of Cross Runners: butt-edge type.
  - c. Face Design: Flat, flush.
  - d. Cap Material: Steel cold-rolled sheet.
  - e. Cap Finish: Painted white.

B. Exposed Suspension System: Type ACP-2 Panels

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. Armstrong World Industries, Inc. Suprafine
  - b. Chicago Metallic Corporation; Tempra 4000
  - c. USG Interiors, Inc; Centricitee
2. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 9/16-inch- wide metal caps on flanges.
  - a. Structural Classification: Intermediate-duty system.
  - b. End Condition of Cross Runners: butt-edge type.
  - c. Face Design: Flat, flush.
  - d. Cap Material: Steel cold-rolled sheet.

- e. Cap Finish: Painted white.

## 2.5 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Provide edge moldings and trim by manufacturer of each corresponding suspension system.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

### 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts,

- eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet . Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
  4. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Resilient base.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

#### 1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Mockups: Provide resilient products with mockups specified in other Sections.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

## 1.7 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F in spaces to receive resilient products during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 RESILIENT BASE

- A. Resilient Base:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
    - b. Flexco, Inc.
    - c. Johnsonite.
    - d. Roppe Corporation, USA.
- B. Resilient Base Standard: ASTM F 1861.
  - 1. Material Requirement: Type TV (vinyl, thermoplastic).
  - 2. Manufacturing Method: Group I (solid, homogeneous).
  - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.

- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Finish: As selected by COTR from manufacturer's full range.
- I. Colors and Patterns: As selected by COTR from full range of industry colors.

## 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
  - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
  1. Remove adhesive and other blemishes from exposed surfaces.
  2. Sweep and vacuum surfaces thoroughly.
  3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION 096513



## SECTION 096623 - RESINOUS MATRIX TERRAZZO FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Thin-set, epoxy-resin terrazzo flooring system.
    - a. In place of cementitious terrazzo to be removed.
    - b. Atop existing cementitious terrazzo.
- B. Related Requirements:
  - 1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:
  - 1. Divider strips.
  - 2. Control-joint strips.
  - 3. Accessory strips.
  - 4. Terrazzo patterns.
  - 5. Dust/fume containment procedures.
- C. Samples for Verification:
  - 1. For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions.
  - 2. Adjust mix proportions for terrazzo sample as may be required by COTR and resubmit until approved by COTR.
  - 3. Prepare Samples of same thickness and from same material to be used for the Work, in size indicated below:
    - a. Terrazzo: 12" square Samples.
    - b. Accessories: 12" long Samples of each exposed strip item required.
- D. Qualification Data: For Installer.

- E. Material Certificates: For each type of terrazzo material or product, from manufacturer.
- F. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- G. Maintenance Data: For terrazzo to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Engage an installer who is a contractor member of NTMA.
  - 2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
- B. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- C. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.
- D. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockups for terrazzo including accessories.
    - a. Size: Minimum 100 sq. ft. of poured-in-place flooring for each color, pattern, and condition in locations acceptable to COTR
    - b. Provide lighting representative of finished project conditions.
  - 2. Approved mockups may become part of the completed Work if undisturbed at the time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
    - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
    - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - c. Review phasing.

- d. Review dust and fume control procedures.
- e. Review special terrazzo designs and patterns.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with sources or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

#### 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.
  - 1. Provide dust and fume-proof partitions and temporary enclosures to limit disturbance of adjacent areas.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- B. FloorScore Compliance: Terrazzo floors shall comply with requirements of FloorScore Standard.
- C. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the

Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.2 EPOXY-RESIN TERRAZZO

### A. Basis of Design Product:

1. Terroxy Resin Systems by Terrazzo & Marble Supply Companies.
2. Subject to compliance with requirements, provide either the named product or a comparable product by another manufacturer including but not limited to the following:
  - a. Crossfield Products Corp., Dex-O-Tex Division;
  - b. General Polymers Corporation;
  - c. Master Terrazzo Technologies LLC;
3. Thickness: 3/8 inch, or as required for alignment with adjacent.
4. Custom Mix Color and Pattern: to match existing, to the satisfaction of Architect and COTR.

### B. Materials:

1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate-crack preparation and reflective-crack reduction.
  - a. Reinforcement: Fiberglass scrim.
2. Primer: Manufacturer's product recommended for substrate and use indicated.
  - a. Where terrazzo is located on lightweight concrete, provide terrazzo manufacturer's recommended barrier primer.
3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.
  - a. Physical Properties without Aggregates:
    - 1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
    - 2) Minimum Tensile Strength: 3000 psi per ASTM D 638 for a 2-inch specimen made using a "C" die per ASTM D 412.
    - 3) Minimum Compressive Strength: 10,000 psi per ASTM D 695, Specimen B cylinder.
    - 4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
      - a) Distilled water.
      - b) Mineral water.
      - c) Isopropanol.
      - d) Ethanol.
      - e) 0.025 percent detergent solution.
      - f) 1.0 percent soap solution.
      - g) 10 percent sodium hydroxide.

- h) 10 percent hydrochloric acid.
      - i) 30 percent sulfuric acid.
      - j) 5 percent acetic acid.
    - b. Physical Properties with Aggregates: For resin blended with Georgia white marble, ground, grouted, and cured per requirements in NTMA's "Terrazzo Specifications and Design Guide"; comply with the following:
      - 1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch per ASTM D 635.
      - 2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F for temperature range of minus 12 to plus 140 deg F per ASTM D 696.
  - 4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
    - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
    - b. 24-Hour Absorption Rate: Less than 0.75 percent.
    - c. Dust Content: Less than 1.0 percent by weight.
  - 5. Finishing Grout: Resin based.
- C. Terrazzo: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and marble-chip proportions and mixing.
  - 1. General:
    - a. Epoxy colors are those of manufacturer of specified Basis-of-Design product.
    - b. Mixes shall comply with performance requirements.
    - c. Blend marble chips in shop.
    - d. Mix proportions:
      - 1) Provide custom terrazzo mixes as specified below, to comply with system manufacturer's recommendations and as required to match COTR's samples.
      - 2) The following proportions may vary up to 10% at no additional cost to the Authority.
  - 2. Terrazzo Type TZ-1 ('Sand')
    - a. Epoxy: Sand Drift 39B-1P
    - b. Marble Chips:
      - 1) 50% China White # 1
      - 2) 20% China White # 2
      - 3) 30% Missouri Botticino #2
  - 3. Terrazzo Type TZ-2 ('Medium Grey')
    - a. Epoxy: Weathered Gray 13C-3D
    - b. Marble Chips:
      - 1) 50% China White #1
      - 2) 20% China White # 2
      - 3) 30% Missouri Botticino #2
  - 4. Terrazzo Type TZ-3 ('Dark Grey')
    - a. Epoxy: Jet Black 78A-1A

- b. Marble Chips:
  - 1) 45% Canadian Blue #1
  - 2) 50% Canadian Blue #2
  - 3) 5% China White #1
- 5. Terrazzo Type TZ-4 ('Blue')
  - a. Epoxy: Grey Duck 73C-2T
  - b. Marble Chips:
    - 1) 20% Canadian Blue #1
    - 2) 20% Canadian Blue #2
    - 3) 30% China White #1
    - 4) 30% Missouri Botticino #2

## 2.3 MISCELLANEOUS MATERIALS

- A. Heavy-Top Divider Strips: L-type angle in depth required for topping thickness indicated.
  - 1. Bottom-Section Material: Aluminum
  - 2. Top-Section Material: Aluminum.
  - 3. Top-Section Width: As indicated.
- B. Control-Joint Strips:
  - 1. Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
  - 2. Provide with pourable flexible joint filler, match color of each terrazzo type.
- C. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
  - 1. Edge-bead strips for exposed edges of terrazzo.
- D. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.
  - 1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Cementitious Fill:
  - 1. Epoxy terrazzo manufacturer's recommended Portland cement-based acrylic patching and fill mortar.
  - 2. Physical Properties:
    - a. Hardness: 70 per ASTM D2240
    - b. Minimum Tensile Strength: 650 psi per ASTM C 190
    - c. Minimum Compressive Strength: 6,000 psi per ASTM C109
    - d. Minimum Bond Strength: 275 psi per ASTM C321, brick bond, 7 day air cure.
- F. Moisture Vapor Treatment:
  - 1. Basis-of-Design Product: The design for moisture vapor treatment is based on Koester VAP I pH by Koester American Corp. Subject to compliance with requirements, provide

- either the named product or a comparable product by another manufacturer including but not limited to the following:
- a. Floor Tech
  2. One-coat, epoxy-resin based treatment for reduction of moisture vapor transmission and pH control in cementitious substrates.
  3. Provide water vapor reduction of concrete substrates of up to 80 percent when tested in accordance with ASTM E96, wet method (reduction of 10 lb to less than 3 lb of water/1000 sq. ft. of slab in 24 hours)
- G. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- H. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- I. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- J. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
  2. Acid-Base Properties: With pH factor between 7 and 10.
  3. Sealers shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete and Cementitious Fill Substrates:
  1. Roughen concrete and cementitious fill substrates as follows:

- a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
  - b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
  - c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
2. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
- a. Moisture Testing: Perform tests indicated below.
    - 1) Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869.
    - 2) If substrates have moisture-vapor-emission rate of 10lb or less of water/1000 sq. ft. of floor in 24 hours, apply moisture vapor treatment before proceeding with application of epoxy terrazzo system. If substrates have moisture-vapor-emission rate of 10lb or more of water/1000 sq. ft. of floor in 24 hours, advise COTR for direction before proceeding.
    - 3) After application and curing of moisture vapor treatment, perform additional anhydrous calcium chloride tests according to ASTM F 1869. Proceed with application of epoxy terrazzo system only after substrates have maximum moisture-vapor-emission rate of 3 lb of water.1000sq. ft. of floors in 24 hours.
    - 4) Perform additional moisture tests as may be recommended by epoxy terrazzo manufacturer. Proceed with application only after substrates pass testing.
- C. Installation of Cementitious Fill:
1. Comply with cementitious fill manufacturer's written instructions for installation.
  2. Mix materials. Trowel apply in thicknesses required to provide uniform 3/8 inch depth for epoxy terrazzo.
  3. Provide smooth troweled finish.
- D. Application of Moisture Vapor Treatment:
1. Comply with moisture vapor treatment manufacturer's written instructions for treatment application.
  2. Dampen concrete and cementitious fill surfaces, leaving no standing water, so that surfaces are damp but not wet to the touch.
  3. Mix materials. Spray apply coat of moisture vapor treatment to full extent of concrete and cementitious fill materials to receive epoxy terrazzo, at coverage rate of 200 sq. ft. per gallon or as otherwise recommended by manufacturer depending on porosity of substrate. Backbrush to eliminate pinholes.
  4. After approximately 20 minutes, backbrush again.
  5. Allow to cure for at least 12 hours before proceeding with epoxy terrazzo applications.
- E. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.



- F. Installation of terrazzo indicates acceptance of surfaces and conditions.

### 3.3 EPOXY-RESIN TERRAZZO INSTALLATION

#### A. General:

1. Comply with NTMA's written recommendations for terrazzo and accessory installation.
2. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."
3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet noncumulative.
4. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
5. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

#### B. Flexible Reinforcing Membrane:

1. Prepare and prefill substrate cracks with membrane material.
2. Install membrane to produce full substrate coverage in areas to receive terrazzo.
  - a. Existing terrazzo flooring: reinforce membrane with fiberglass scrim over full extent of existing terrazzo flooring.
  - b. Other locations: Install continuous 4 foot wide strips of fiberglass scrim centered on column centerlines, in each direction.
3. Prepare membrane according to manufacturer's written instructions before applying substrate primer.

#### C. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.

#### D. Strip Materials:

##### 1. Divider and Control-Joint Strips:

- a. Locate divider strips in locations indicated.
- b. Install control-joint strips centered on column centerlines in each direction, and as indicated on Drawings.
- c. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.
- d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

### 3.4 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

### 3.5 CLEANING AND PROTECTION

#### A. Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

#### B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

#### C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096623

## SECTION 099123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Gypsum board.
  - 2. Hollow Metal Doors and Frames.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 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.
- D. Product List: For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
  - 3. VOC content.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from the same product run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

## 1.5 QUALITY ASSURANCE

### A. MPI Standards:

1. Preparation and Workmanship: Comply with the requirements in “MPI Architectural Painting and Specification Manual” and MPI Maintenance Repainting Manual” for products and paint systems indicated.

### B. Color Requirements:

1. Specified Paint Schedule lists basic painting systems
2. Prior to beginning painting Work, COTR will prepare and furnish a Color Schedule accompanied by color chips.
3. Color Schedule shall list areas and surfaces to be painted together with colors, textures and sheens required for various surfaces.
4. Multiple colors will be required
5. Colors may be custom colors, not limited to manufacturer’s standard colors.
6. Include cutting in of different colors in the Work.

### C. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. COTR will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
  - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft
  - b. Other Items: COTR will designate items or areas required.
2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on mockups.
  - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by COTR at no added cost to Owner.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 DELIVERY, STORAGE, AND HANDLING

### A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

## 1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers:
  - 1. Basis-of-Design Products: Design for exterior paint is based on the scheduled products by Benjamin Moore & Co.
  - 2. Subject to compliance with requirements, provide the scheduled products or comparable products by other manufacturers including, but not limited to, the following:
    - a. Duron, Inc.
    - b. PPG Architectural Finishes, Inc.
    - c. Sherwin-Williams Company (The).

### 2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. 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.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction[ and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
  - 1. Flat Paints and Coatings: 50 g/L.
  - 2. Nonflat Paints and Coatings: 150 g/L.
  - 3. Floor Coatings: 100 g/L.
- D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- E. Colors: As selected by COTR from manufacturer's full range.

## 2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  - 2. Testing agency will perform tests for compliance with product requirements.
  - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
  - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed in occupied spaces:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.

- c. Uninsulated plastic piping.
  - d. Pipe hangers and supports.
  - e. Metal conduit.
  - f. Plastic conduit.
  - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
  - h. Other items as directed by COTR.
2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board Substrates – Flat:
  1. First Coat: Vinyl acrylic primer:
    - a. Available product: Regal First Coat Interior Latex Primer & Underbody 216 by Benjamin Moore.
  2. Second Coat: Vinyl acrylic latex, flat
    - a. Available product: Regal Wall Satin 215 by Benjamin Moore.
  3. Third Coat: Same as second coat.
  4. Ceilings and soffits
- B. Gypsum Board Substrates –Eggshell:
  1. First Coat: Vinyl acrylic primer:
    - a. Available product: Regal First Coat Interior Latex Primer & Underbody 216 by Benjamin Moore.
  2. Second Coat: Vinyl acrylic latex, eggshell
    - a. Available product: Regal Wall Aqua Velvet 319 by Benjamin Moore.
  3. Third Coat: Same as second coat.
  4. Locations: Walls
- C. Steel Substrates – Alkyd:
  1. Primer: Rust inhibiting alkyd primer; touch up shop primed items.



- a. Available product: Moorcraft Superspec DTM Alkyd Satin Z163 by Benjamin Moore.
2. Second coat: Alkyd enamel, high gloss
  - a. Available product: Moorcraft Superspec Urethane Gloss Enamel Z 22 by Benjamin Moore.
3. Third coat: same as second coat.
4. Locations:
  - a. Doors and frames
  - b. Any exposed mechanical, plumbing, fire protection, and electrical Work
  - c. Any exposed miscellaneous metals and non-stainless items.

END OF SECTION 099123

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## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipes, fittings, and specialties.
  - 2. Sprinklers.

#### 1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

#### 1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
  - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

## 1.6 SUBMITTALS

1. Product Data: For each type of product indicated.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
  1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Domestic water piping.
  2. Items penetrating finished ceiling include the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
- E. Qualification Data: For qualified Installer and professional engineer.
- F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- G. Welding certificates.
- H. Fire-hydrant flow test report.
- I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- J. Field quality-control reports.
- K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

- a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
  - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

## 1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sprinkler service.
  - 2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

## 1.9 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

### 2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Schedule 40. Pipe ends may be factory or field formed to match joining method.

- B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

## 2.3 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

## 2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.
  - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- C. Adjustable Drop Nipples:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CECA, LLC.
    - b. Corcoran Piping System Co.
    - c. Merit Manufacturing; a division of Anvil International, Inc.
  - 2. Standard: UL 1474.
  - 3. Pressure Rating: 250 psig (1725 kPa) minimum.
  - 4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
  - 5. Size: Same as connected piping.
  - 6. Length: Adjustable.
  - 7. Inlet and Outlet: Threaded.

## 2.5 SPRINKLERS

- 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. AFAC Inc.
  2. Globe Fire Sprinkler Corporation.
  3. Reliable Automatic Sprinkler Co., Inc.
  4. Tyco Fire & Building Products LP.
  5. Venus Fire Protection Ltd.
  6. Victaulic Company.
  7. Viking Corporation.
- B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  2. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
  2. Nonresidential Applications: UL 199.
  3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:
1. Chrome plated.
- E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch (25-mm) vertical adjustment.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

### 3.2 WATER-SUPPLY CONNECTIONS

- A. Connect new sprinkler piping to building's interior existing water-distribution piping.

### 3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- D. Fill sprinkler system piping with water.
- E. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- E. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- F. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.



- G. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- H. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.7 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

### 3.8 PIPING SCHEDULE

- A. Standard-pressure, wet-pipe sprinkler system, **NPS 2 (DN 50)** and smaller, shall be one of the following:
  - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. **Type L (Type B)**, hard copper tube with plain ends; cast- or wrought-copper solder-joint fittings; and brazed joints.

## PART 4 - CONTRACTOR QUALITY CONTROL REQUIREMENTS

### 4.1 GENERAL

- A. Division 1 Section “Quality Requirements” specifies requirements for the Contractor’s quality control program. The following additional testing and inspection requirements are required in the Contractor’s Quality Control Program for the work of this section. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services to not relieve Contractor of responsibility for compliance with the Contract Document requirements.

### 4.2 FIELD QUALITY CONTROL

- A. Contractor Supervision: Provide supervision for wet pipe sprinkler systems installations and their testing. Inspect wet pipe sprinkler systems and testing reports for conformance with requirements. The Contractor shall notify the Architect at least 72 hours in advance of inspection so that appropriate representatives may attend.

END OF SECTION 211313

## SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
  2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

### PART 2 - PRODUCTS

#### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

- B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

- C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

#### 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa), ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend **2 inches (50 mm)** beyond sheet metal shield for piping operating below ambient air temperature.

## 2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: **5000-psi (34.5-MPa)**, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.
  - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
  - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
  - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. **NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.**
  - b. **NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.**
  - c. **NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.**
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.



- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
  - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36 (DN 20 to DN 900)**, requiring clamp flexibility and up to **4 inches (100 mm)** of insulation.
  - 3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
  - 4. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
  - 5. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30 (DN 25 to DN 750)**, from two rods if longitudinal movement caused by expansion and contraction might occur.
  - 6. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42 (DN 50 to DN 1050)** if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24 (DN 24 to DN 600)**.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24 (DN 20 to DN 600)** if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to **6 inches (150 mm)** for heavy loads.
  - 2. Steel Clevises (MSS Type 14): For **120 to 450 deg F (49 to 232 deg C)** piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb (340 kg).
    - b. Medium (MSS Type 32): 1500 lb (680 kg).
    - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

## SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.

#### 1.2 ACTION SUBMITTAL

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

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

##### A. Metal Labels for Equipment:

1. Material and Thickness: Stainless steel, 0.025-inch (0.64-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
3. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

##### B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black
3. Background Color: White
4. Maximum Temperature: Able to withstand temperatures up to **160 deg F (71 deg C)**.
5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
6. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**.

- mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 7. Fasteners: Stainless-steel rivets or self-tapping screws.
- 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Red
- C. Background Color: White
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least **1-1/2 inches (38 mm)** high.

## 2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White
- D. Maximum Temperature: Able to withstand temperatures up to **160 deg F (71 deg C)**.
- E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
- F. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least **1-1/2 inches (38 mm)** high.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

### 3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
  - 1. Chilled-Water Piping:
    - a. Background Color: White
    - b. Letter Color: Blue
  - 2. Heating Water Piping:
    - a. Background Color: White
    - b. Letter Color: Red

### 3.4 DUCT LABEL INSTALLATION

- A. Install permanent self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For cold-air supply ducts.
  - 2. Yellow: For hot-air supply ducts.
  - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 230553

## SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Balancing Air Systems:
  - a. Constant-volume air systems.
  - b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
  - a. Constant-flow hydronic systems.
  - b. Variable-flow hydronic systems.

#### 1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

#### 1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.
  1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
  2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

- B. Certify TAB field data reports and perform the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Construction Manager.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.



2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
  - G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
  - H. Examine test reports specified in individual system and equipment Sections.
  - I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
  - J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
  - K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
  - L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
  - M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
  - N. Examine system pumps to ensure absence of entrained air in the suction piping.
  - O. Examine operating safety interlocks and controls on HVAC equipment.
  - P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.
- 3.2 PREPARATION
- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
  - B. Complete system-readiness checks and prepare reports. Verify the following:
    1. Permanent electrical-power wiring is complete.
    2. Hydronic systems are filled, clean, and free of air.
    3. Automatic temperature-control systems are operational.
    4. Equipment and duct access doors are securely closed.
    5. Balance, smoke, and fire dampers are open.
    6. Isolating and balancing valves are open and control valves are operational.
    7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
    8. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
  - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.

- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

### 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 6. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure airflow of submain and branch ducts.

- a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  3. Measure total system airflow. Adjust to within indicated airflow.
  4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

- a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
  7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
  2. Set terminal units and supply fan at full-airflow condition.
  3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  4. Readjust fan airflow for final maximum readings.
  5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
  6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
  7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
  8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
  2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
  3. Set terminal units at full-airflow condition.

4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

### 3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check liquid level in expansion tank.
  3. Check makeup water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### 3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Construction Manager and comply with requirements in Section 232123 "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
  - C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
  - D. Set calibrated balancing valves, if installed, at calculated presettings.
  - E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
    1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
  - F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
  - G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
    1. Determine the balancing station with the highest percentage over indicated flow.
    2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
    3. Record settings and mark balancing devices.
  - H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
  - I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
  - J. Check settings and operation of each safety valve. Record settings.
- 3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS
- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

### 3.10 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### 3.11 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

### 3.12 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check the condition of coils.
5. Check the operation of the drain pan and condensate-drain trap.
6. Check bearings and other lubricated parts for proper lubrication.
7. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:



1. New filters are installed.
  2. Coils are clean and fins combed.
  3. Drain pans are clean.
  4. Fans are clean.
  5. Bearings and other parts are properly lubricated.
  6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  4. Balance each air outlet.

### 3.13 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  2. Air Outlets and Inlets: Plus or minus 10 percent.
  3. Heating-Water Flow Rate: Plus or minus 10 percent.
  4. Cooling-Water Flow Rate: Plus or minus 10 percent.

### 3.14 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.15 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
  2. Name and address of the TAB contractor.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water flow rates.
  3. Duct, outlet, and inlet sizes.

4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

### 3.16 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

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## SECTION 230713 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, concealed return located in unconditioned space.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following] available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.

## 2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; FlameChek.
    - b. Johns Manville; Firetemp Wrap.
    - c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
    - d. Thermal Ceramics; FireMaster Duct Wrap.
    - e. 3M; Fire Barrier Wrap Products.
    - f. Unifrax Corporation; FyreWrap.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
  - b. Eagle Bridges - Marathon Industries; 225.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
  - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.



2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
  - b. Eagle Bridges - Marathon Industries; 550.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
  - d. Mon-Eco Industries, Inc.; 55-50.
  - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

## 2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Eagle Bridges - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
  - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).**
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
  5. Vinyl Jacket: White vinyl with a permeance of **1.3 perms (0.86 metric perm)** when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately **1 oz./sq. yd. (34 g/sq. m)** with a thread count of **10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm)**, in a Leno weave, for ducts.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
    - b. Vimasco Corporation; Elastafab 894.

## 2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  - 2. Adhesive: As recommended by jacket material manufacturer.
  - 3. Color: White
- D. Aluminum Jacket: Comply with **ASTM B 209 (ASTM B 209M)**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
    - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
    - c. RPR Products, Inc.; Insul-Mate.
  - 2. Factory cut and rolled to size.
  - 3. Finish and thickness are indicated in field-applied jacket schedules.
  - 4. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following] available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 11.5 mils (0.29 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches (75 mm).
  3. Thickness: 6.5 mils (0.16 mm).
  4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  2. Width: 2 inches (50 mm).
  3. Thickness: 6 mils (0.15 mm).
  4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
  5. Elongation: 500 percent.

6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

- a. ABI, Ideal Tape Division; 488 AWF.
- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
- c. Compac Corporation; 120.
- d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).

3. Thickness: 3.7 mils (0.093 mm).

4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

## 2.10 SECUREMENTS

A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

- a. ITW Insulation Systems; Gerrard Strapping and Seals.
- b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Stainless Steel: ASTM A167 or ASTM 240/240A, 304 or type 316; 0.015 inch (0.38 mm) with wing seal or closed seal.

C. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

- a. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
  - 2) GEMCO; Perforated Base.
  - 3) Midwest Fasteners, Inc.; Spindle.

- b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
    - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) GEMCO; Nylon Hangers.
      - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
    - b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
    - c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
      - 2) GEMCO; Peel & Press.
      - 3) Midwest Fasteners, Inc.; Self Stick.
    - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
    - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive-backed base with a peel-off protective cover.
  4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

- a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- D. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- E. Wire: 0.062-inch (1.6-mm) soft-annealed, galvanized steel

## 2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.

- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with **3-inch- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
  - 3. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2 inches (50 mm)** o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches (100 mm)** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.



1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches (50 mm)**.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least **2 inches (50 mm)**.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least **2 inches (50 mm)**.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
- ### 3.4 INSTALLATION OF MINERAL-FIBER INSULATION
- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions **18 inches (450 mm)** and smaller, place pins along longitudinal centerline of duct. Space **3 inches (75 mm)** maximum from insulation end joints, and **16 inches (400 mm)** o.c.
    - b. On duct sides with dimensions larger than **18 inches (450 mm)**, place pins **16 inches (400 mm)** o.c. each way, and **3 inches (75 mm)** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches (50 mm)** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch (13-mm)** outward-clinching staples, **1 inch (25 mm)** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below **50 deg F (10 deg C)** at **18-foot (5.5-m)** intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches (75 mm)**.
  5. Overlap unfaced blankets a minimum of **2 inches (50 mm)** on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of **18 inches (450 mm)** o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch- (150-mm-)** wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches (150 mm)** o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions **18 inches (450 mm)** and smaller, place pins along longitudinal centerline of duct. Space **3 inches (75 mm)** maximum from insulation end joints, and **16 inches (400 mm)** o.c.
  - b. On duct sides with dimensions larger than **18 inches (450 mm)**, space pins **16 inches (400 mm)** o.c. each way, and **3 inches (75 mm)** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches (50 mm)** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch (13-mm)** outward-clinching staples, **1 inch (25 mm)** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below **50 deg F (10 deg C)** at **18-foot (5.5-m)** intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches (75 mm)**.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch- (150-mm-)** wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches (150 mm)** o.c.

### 3.5 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with **1-1/2-inch (38-mm)** laps at longitudinal seams and **3-inch- (75-mm-)** wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with **1-inch (25-mm)** overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with **2-inch (50-mm)** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches (300 mm)** o.c. and at end joints.

### 3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

### 3.7 FINISHES

- A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
  - B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
  - C. Do not field paint aluminum or stainless-steel jackets.

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.9 DUCT INSULATION SCHEDULE, GENERAL

#### A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, concealed return located in unconditioned space.
3. Indoor, exposed return located in unconditioned space.
4. Outdoor, concealed supply and return.
5. Outdoor, exposed supply and return.

#### B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

### 3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
- B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
- C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches (38 mm) 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.
- D. Concealed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches (50 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

### 3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
  - 1. None.

END OF SECTION 230713

## SECTION 230719 - HVAC PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Chilled-water and brine piping, indoors.
2. Heating hot-water piping, indoors.

B. Related Sections:

1. Section 230713 "Duct Insulation."

#### 1.2 SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

#### 1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. **Products:** Subject to compliance with requirements provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. [Pittsburgh Corning Corporation](#);
  - 2. Block Insulation: ASTM C 552, Type I.
  - 3. Special-Shaped Insulation: ASTM C 552, Type III.
  - 4. Board Insulation: ASTM C 552, Type IV.
  - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  - 6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
  - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. [Aeroflex USA, Inc.; Aerocel](#).
    - b. [Armacell LLC; AP Armaflex](#).
    - c. [K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS](#).
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 1290, Type I.
  - 1. **Products:** Subject to compliance with requirements provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:



- a. [CertainTeed Corp.; SoftTouch Duct Wrap.](#)
- b. [Johns Manville; Microlite.](#)
- c. [Knauf Insulation; Friendly Feel Duct Wrap.](#)
- d. [Manson Insulation Inc.; Alley Wrap.](#)
- e. [Owens Corning; SOFTR All-Service Duct Wrap.](#)

H. Mineral-Fiber, Preformed Pipe Insulation:

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. [Fibrex Insulations Inc.; Coreplus 1200.](#)
  - b. [Johns Manville; Micro-Lok.](#)
  - c. [Knauf Insulation; 1000-Degree Pipe Insulation.](#)
  - d. [Manson Insulation Inc.; Alley-K.](#)
  - e. [Owens Corning; Fiberglas Pipe Insulation.](#)
2. Type I, **850 deg F (454 deg C)** Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, **1200 deg F (649 deg C)** Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory-applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. [Knauf Insulation; Permawick Pipe Insulation.](#)
  - b. [Owens Corning; VaporWick Pipe Insulation.](#)

J. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. [Armacell LLC; Tubolit.](#)
  - b. [Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.](#)

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of **minus 100 to plus 200 deg F (minus 73 to plus 93 deg C)**.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
    - .
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aeroflex USA, Inc.; Aero seal.
    - b. Armacell LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
  - b. Eagle Bridges - Marathon Industries; 225.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
  - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
  - b. Eagle Bridges - Marathon Industries; 225.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
  - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Dow Corning Corporation; 739, Dow Silicone.
  - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
  - c. P.I.C. Plastics, Inc.; Welding Adhesive.
  - d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
  - b. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm (0.009 metric perm)** at **43-mil (1.09-mm)** dry film thickness.
3. Service Temperature Range: **Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).**
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
  - b. Eagle Bridges - Marathon Industries; 550.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
  - d. Mon-Eco Industries, Inc.; 55-50.
  - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, **1.8 perms (1.2 metric perms)** at **0.0625-inch (1.6-mm)** dry film thickness.
3. Service Temperature Range: **Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).**
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

## 2.5 SEALANTS

### A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - b. Eagle Bridges - Marathon Industries; 405.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).**
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.6 TAPES

### A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. ABI, Ideal Tape Division; 428 AWF ASJ.
  - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
  - c. Compac Corporation; 104 and 105.
  - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: **3 inches (75 mm).**
3. Thickness: **11.5 mils (0.29 mm).**
4. Adhesion: **90 ounces force/inch (1.0 N/mm)** in width.
5. Elongation: 2 percent.
6. Tensile Strength: **40 lbf/inch (7.2 N/mm)** in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

### B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
    - e. .
  2. Width: **3 inches (75 mm).**
  3. Thickness: **6.5 mils (0.16 mm).**
  4. Adhesion: **90 ounces force/inch (1.0 N/mm)** in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: **40 lbf/inch (7.2 N/mm)** in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  2. Width: **2 inches (50 mm).**
  3. Thickness: **6 mils (0.15 mm).**
  4. Adhesion: **64 ounces force/inch (0.7 N/mm)** in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: **18 lbf/inch (3.3 N/mm)** in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 488 AWF.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. Compac Corporation; 120.
    - d. Venture Tape; 3520 CW.
  2. Width: **2 inches (50 mm).**
  3. Thickness: **3.7 mils (0.093 mm).**
  4. Adhesion: **100 ounces force/inch (1.1 N/mm)** in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: **34 lbf/inch (6.2 N/mm)** in width.

- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
  2. Width: **3 inches** (75 mm).
  3. Film Thickness: **4 mils** (0.10 mm).
  4. Adhesive Thickness: **1.5 mils** (0.04 mm).
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: **55 lbf/inch** (10.1 N/mm) in width.
- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
  2. Width: **3 inches** (75 mm).
  3. Film Thickness: **6 mils** (0.15 mm).
  4. Adhesive Thickness: **1.5 mils** (0.04 mm).
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: **55 lbf/inch** (10.1 N/mm) in width.

## 2.7 SECUREMENTS

- A. Aluminum Bands: **ASTM B 209** (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, **1/2 inch** (13 mm) wide with wing seal or closed seal.
1. **Products:** Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ITW Insulation Systems; Gerrard Strapping and Seals.
    - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
- B. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** (19-mm-) wide, stainless steel or Monel.
- C. Wire: **0.062-inch** (1.6-mm) soft-annealed, galvanized steel.
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. C & F Wire.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.



4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with **3-inch- (75-mm-)** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches (100 mm)** o.c.
  3. Overlap jacket longitudinal seams at least **1-1/2 inches (38 mm)**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **4 inches (100 mm)** o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches (100 mm)** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### 3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

- install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches (50 mm)** below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches (50 mm)**.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached

insulation, to flanges with tie wire. Extend insulation at least **2 inches (50 mm)** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at **6 inches (150 mm)** o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  - 1. Install pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.
  - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
  - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  - 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at **6 inches (150 mm)** o.c.
  - 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch (25 mm)**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 FINISHES

- A. Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Chilled Water and Brine, above 40 Deg F (5 Deg C): Insulation shall be one of the following:
  - 1. Cellular Glass: 2 inches (50 mm) thick.
  - 2. Mineral-Fiber, Preformed Pipe, Type I or Pipe Insulation Wicking System: 2 inches (50 mm) thick.
  - 3. Polyolefin: 2 inch (50 mm) thick.
- B. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below: Insulation shall be one of the following:
  - 1. Cellular Glass: 1-1/2 inches (38 mm) thick.
  - 2. Mineral-Fiber, Preformed Pipe, Type I: 1 inch (25 mm) thick.

### 3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  - 1. None.
- D. Piping, Exposed:
  - 1. None.

END OF SECTION 230719



## SECTION 233113 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

##### B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "HVAC Duct Construction Standard - -Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  2. Factory- and shop-fabricated ducts and fittings.

3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

#### 1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
  - a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
  - f. Perimeter moldings.

B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural

Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## PART 2 - PRODUCTS

### 2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Lindab Inc.
  - b. McGill AirFlow LLC.
  - c. SEMCO Incorporated.
  - d. Sheet Metal Connectors, Inc.
  - e. Spiral Manufacturing Co., Inc.
  
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
  
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  1. Fabricate round ducts larger Than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
  
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
  
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  1. Galvanized Coating Designation: G90 (Z275).
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
  
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with **ASTM B 209 (ASTM B 209M)** Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, **1/4-inch (6-mm)** minimum diameter for lengths **36 inches (900 mm)** or less; **3/8-inch (10-mm)** minimum diameter for lengths longer than **36 inches (900 mm)**.

## 2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: **4 inches**.
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: **10-inch wg (2500 Pa)**, positive and negative.
  - 7. Service: Indoor and outdoor.
  - 8. Service Temperature: **Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C)**.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.

6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES

- A. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- B. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- C. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- D. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

- H. Install ducts with a clearance of **1 inch (25 mm)**, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least **1-1/2 inches (38 mm)**.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. Outdoor, Exhaust Ducts: Seal Class C.
  - 4. Outdoor, Return-Air Ducts: Seal Class C.



5. Unconditioned Space, Supply-Air Ducts in Pressure Classes **2-Inch wg (500 Pa)** and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than **2-Inch wg (500 Pa)**: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes **2-Inch wg (500 Pa)** and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than **2-Inch wg (500 Pa)**: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than **4 inches (100 mm)** thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than **4 inches (100 mm)** thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1 (Table 5-1M)**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within **24 inches (610 mm)** of each elbow and within **48 inches (1200 mm)** of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of **16 feet (5 m)**.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.6 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
  - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

### 3.7 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.8 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

- B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive **2-inch wg (500 Pa)**.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 12.
- d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Equipment Not Listed Above:

- a. Pressure Class: Positive **2-inch wg (500 Pa)**.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 12.
- d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to Air-Handling Units:

- a. Pressure Class: Positive or negative **3-inch wg (750 Pa)**.
- b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
- c. SMACNA Leakage Class for Rectangular: 6.
- d. SMACNA Leakage Class for Round and Flat Oval: 6.

- C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. PVC-Coated Ducts:

- a. Exposed to Airstream: Match duct material.
- b. Not Exposed to Airstream: Match duct material.

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm (5 m/s) or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm (7.6 m/s) or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.

- 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
  - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
  - 4) Radius-to Diameter Ratio: 1.5.
- b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam or Welded.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
  - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

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## SECTION 233300 - AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.

#### 1.2 ACTION SUBMITTALS

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

##### B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
  - a. Special fittings.
  - b. Manual volume damper installations.
  - c. Control-damper installations.
  - d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
  - e. Wiring Diagrams: For power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

##### A. Operation and maintenance data.

## PART 2 - PRODUCTS

### 2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

### 2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: **G90 (Z275)**.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- C. Aluminum Sheets: Comply with **ASTM B 209 (ASTM B 209M)**, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with **ASTM B 221 (ASTM B 221M)**, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, **1/4-inch (6-mm)** minimum diameter for lengths **36 inches (900 mm)** or less; **3/8-inch (10-mm)** minimum diameter for lengths longer than **36 inches (900 mm)**.

### 2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. American Warming and Ventilating; a division of Mestek, Inc.
    - c. Flexmaster U.S.A., Inc.
    - d. McGill AirFlow LLC.
    - e. Nailor Industries Inc.
    - f. Pottorff.
    - g. Ruskin Company.



- h. Trox USA Inc.
  - i. Vent Products Company, Inc.
- 2. Standard leakage rating, with linkage outside airstream.
  - 3. Suitable for horizontal or vertical applications.
  - 4. Frames:
    - a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
  - 6. Blade Axles: Galvanized steel.
  - 7. Bearings:
    - a. Oil-impregnated bronze.
    - b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  - 8. Tie Bars and Brackets: Galvanized steel.

## 2.4 FIRE DAMPERS

- 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. Air Balance Inc.; a division of Mestek, Inc.
  - 2. Arrow United Industries; a division of Mestek, Inc.
  - 3. Cesco Products; a division of Mestek, Inc.
  - 4. Greenheck Fan Corporation.
  - 5. Nailor Industries Inc.
  - 6. NCA Manufacturing, Inc.
  - 7. Pottorff.
  - 8. Prefco; Perfect Air Control, Inc.
  - 9. Ruskin Company.
  - 10. Vent Products Company, Inc.
  - 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Static; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 2 hours.

- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
  - 1. Minimum Thickness: 0.39 inch (9.9 mm) thick, as indicated, and of length to suit application.
  - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 212 deg F (100 deg C) rated, fusible links.
- K. Heat-Responsive Device: Electric or pneumatic resettable/replaceable link and switch package, factory installed, 212 deg F (100 deg C) rated.

## 2.5 FLANGE CONNECTORS

- 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. Ductmate Industries, Inc.
  - 2. Nexus PDQ; Division of Shilco Holdings Inc.
  - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## 2.6 TURNING VANES

- 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. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. Elgen Manufacturing.
  - 4. METALAIRE, Inc.

5. SEMCO Incorporated.
  6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall.

## 2.7 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. Elgen Manufacturing.
  4. Ventfabrics, Inc.
  5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip **5-3/4 inches (146 mm)** wide attached to two strips of **2-3/4-inch- (70-mm-)** wide, **0.028-inch- (0.7-mm-)** thick, galvanized sheet steel or **0.032-inch- (0.8-mm-)** thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: **26 oz./sq. yd. (880 g/sq. m).**
  2. Tensile Strength: **480 lbf/inch (84 N/mm)** in the warp and **360 lbf/inch (63 N/mm)** in the filling.
  3. Service Temperature: **Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).**

## 2.8 FLEXIBLE DUCTS

- 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. Flexmaster U.S.A., Inc.
  2. McGill AirFlow LLC.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
  2. Maximum Air Velocity: 4000 fpm (20 m/s).
  3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
  4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- C. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
  2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

## 2.9 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
1. Install steel volume dampers in steel ducts.
  2. Install aluminum volume dampers in aluminum ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.

- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream and downstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 7. At each change in direction and at maximum 50-foot (15-m) spacing.
  - 8. Upstream and downstream from turning vanes.
  - 9. Upstream or downstream from duct silencers.
  - 10. Control devices requiring inspection.
  - 11. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
  - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
  - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
  - 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
  - 5. Body Access: 25 by 14 inches (635 by 355 mm).
  - 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- J. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. Connect terminal units to supply ducts with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.
- M. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.
- N. Connect flexible ducts to metal ducts with draw bands.
- O. Install duct test holes where required for testing and balancing purposes.

### 3.2 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

## SECTION 233600 - AIR TERMINAL UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Fan-powered air terminal units.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "HVAC Duct Construction Standards – Metal and Flexible Duct."

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
- C. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

### PART 2 - PRODUCTS

#### 2.1 PARALLEL FAN-POWERED AIR TERMINAL UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Environmental Technologies, Inc.
  2. Nailor Industries Inc.
  3. Titus.
  4. Trane; a business of American Standard Companies.

- B. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with control components inside a protective metal shroud.
- C. Terminals should be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Non-certified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineer in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
- D. The terminal shall be designed, built, and tested as a single unit including motor and fan assembly, primary air damper assembly, water or electric heating coils, and accessories as shipped. All electrical components shall be UL listed and installed in accordance with UL standard 1995. Electrical connection shall be single point. All electrical components, including low voltage controls, shall be mounted in sheet metal control enclosures. The entire terminal shall be ETL listed as a complete assembly.
- E. Steri-Loc Liner: The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with non-porous, sealed liner which complies to UL 181 and NFPA 90A. Insulation shall be 4 pound density. All cut edges must be sealed from the airstream using mechanically bonded barrier strips. Liners made of Tedlar, Silane, or woven fiberglass cloth are not acceptable. Insulation shall be equivalent to Titus Steri-Loc. Double wall lining is acceptable. The terminal shall have a round duct connection and a rectangular discharge suitable for flanged duct connection. The casing shall be designed for hanging by sheet metal straps.
- F. The terminal casing shall have a bottom access panel which allows removal of fan and servicing of terminal without disturbing duct connections.
- G. The fan shall be constructed of steel and have a forward curved, dynamically balanced wheel with direct drive motor. The motor shall be suitable for 120, 208, 240, or 277 volt, 60 cycle, single phase power. The motor shall be of energy efficient design, permanent split capacitor type, with integral thermal overload protection and permanently lubricated bearings, and be specifically designed for use with an SCR for fan speed adjustment. Fan assembly shall include a tuned spring steel suspension and isolation between motor and fan housing.
- H. The terminals shall utilize a manual SCR, which allows continuously adjustable fan speed from maximum to minimum, as a means of setting fan airflow. Setting fan airflow with any device that raises the pressure across the fan to reduce airflow is not acceptable. The speed control shall incorporate a minimum voltage stop to insure that the motor cannot operate in a stall mode.
- I. The terminals shall include a gasketed backdraft damper at the fan section discharge to prevent primary air from flowing back through the fan section into the return air plenum.
- J. The primary air damper assembly shall be heavy gauge steel with shaft rotating in Delrin self lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking, and a synthetic seal to limit close-off leakage to the maximum values shown in the following table.
- K. Sound ratings for the terminals shall not exceed 25 NC. Sound performance shall be ARI certified. The radiated and discharge path attenuation function for the specified NC shall be



based upon factors found in ARI Standard 885-98 and in the preceding tables. No additional attenuation factors shall be deducted from the sound power.

- L. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with engineered polymer foam insulation which complies to UL181 and NFPA 90A. Insulation shall be 1½ pound density, closed cell foam. Exposed fiberglass is not acceptable. The insulation shall be mechanically fastened to the unit casing. The casing shall be designed for hanging by sheet metal brackets.
- M. Hot water heating coils shall be enclosed in a minimum 20-gauge galvanized steel casing, with flanged construction for attachment to metal ductwork. Coils shall be factory installed on the terminal. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016 inch, with male solder header connections. Coils shall be leak tested to 300 psi, with minimum burst pressure of 1800 psi at ambient temperature. Number of coil rows and circuits shall be selected to provide performance as required per the plans.
- N. Accessories: Hot water heating coils shall be enclosed in a minimum 20-gauge galvanized steel casing, with flanged construction for attachment to metal ductwork. Coils shall be factory installed on the terminal. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016 inch, with male solder header connections. Coils shall be leak tested to 300 psi, with minimum burst pressure of 1800 psi at ambient temperature. Number of coil rows and circuits shall be selected to provide performance as required per the plans.

## 2.2 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Steel Cables: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

## 2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
  - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, and ARI certification seal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches (100 mm) thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches (100 mm) thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Connect ducts to air terminal units according to Section 233113 "Metal Ducts."
- C. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

### 3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. **Manufacturer's Field Service:** Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. **Leak Test:** After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. **Operational Test:** After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
  - 3. Verify that controls and control enclosure are accessible.
  - 4. Verify that control connections are complete.
  - 5. Verify that nameplate and identification tag are visible.
  - 6. Verify that controls respond to inputs as specified.

### 3.7 DEMONSTRATION

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

END OF SECTION 233600

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## SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Rectangular and square ceiling diffusers.
  - 2. Perforated diffusers.
  - 3. Louver face diffusers.
  
- B. Related Sections:
  - 1. Section 089000 "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
  - 2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

### PART 2 - PRODUCTS

- A. Louver Face Diffuser:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. METALAIRE, Inc.
    - b. Titus.
    - c. Tuttle & Bailey.
  - 2. Devices shall be specifically designed for variable-air-volume flows.
  - 3. Material: Steel.
  - 4. Finish: Baked enamel, white.
  - 5. Face Size: 24 inches x 24 inches.
  - 6. Mounting: T-bar and Mounting panel.
  - 7. Pattern: Four-way Adjustable core style.
  - 8. Dampers: Butterfly.
  - 9. Accessories:

- a. Square to round neck adaptor.
- b. Adjustable pattern vanes.
- c. Throw reducing vanes.
- d. Equalizing grid.
- e. Plaster ring.
- f. Safety chain.
- g. Wire guard.
- h. Sectorizing baffles.

## 2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 INFORMATIONAL SUBMITTALS

- ##### A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

- ##### A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- ##### B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2, THWN-2 and Type SO.
- ##### C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC and Type SO with ground wire.

#### 2.2 CONNECTORS AND SPLICES

- ##### A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

#### 2.3 SYSTEM DESCRIPTION

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

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- D. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."



### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### 3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

- c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report to record the following:
- 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Grounding systems and equipment.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

## 2.2 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. [2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.

- B. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
  - 1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.
  - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

### 3.3 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
  - 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Make tests at ground rods before any conductors are connected.
- B. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

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## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For steel slotted support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
1. Trapeze hangers. Include Product Data for components.
  2. Steel slotted channel systems. Include Product Data for components.
  3. Equipment supports.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

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

- B. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti Inc.



- 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
  - 3) MKT Fastening, LLC.
  - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
    - 2) Empire Tool and Manufacturing Co., Inc.
    - 3) Hilti Inc.
    - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
    - 5) MKT Fastening, LLC.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  6. Toggle Bolts: All-steel springhead type.
  7. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be **1/4 inch (6 mm)** in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for **1-1/2-inch (38-mm)** and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus **200 lb (90 kg)**.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete **4 inches (100 mm)** thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than **4 inches (100 mm)** thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in [Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. ARC: Comply with ANSI C80.5 and UL 6A.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.

## 2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

## 2.3 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- D. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing **50 lb (23 kg)**. Outlet boxes designed for attachment of luminaires weighing more than **50 lb (23 kg)** shall be listed and marked for the maximum allowable weight.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: **4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep)**.
- I. Gangable boxes are allowed.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250 Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
  1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  2. Nonmetallic Enclosures: Plastic.
  3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  1. Exposed Conduit: GRC.
  2. Concealed Conduit, Aboveground: [EMT.
  3. Underground Conduit: RNC, Type EPC-40-PVC], direct buried.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R .
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
  1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT.
  3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - b. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: GRC.
  7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: **3/4-inch (21-mm)** trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use compression fittings. Comply with NEMA FB 2.10.
  4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds **120 deg F (49 deg C)** .
- ### 3.2 INSTALLATION
- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
  - B. Keep raceways at least **6 inches (150 mm)** away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
  - C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
  - D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
  - E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within **12 inches (300 mm)** of changes in direction.
  - F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.



- G. Support conduit within **12 inches (300 mm)** of enclosures to which attached.
- H. Raceways Embedded in Slabs:
1. Run conduit larger than **1-inch (27-mm)** trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum **10-foot (3-m)** intervals.
  2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  3. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  4. Change from ENT to RNC, Type EPC-40-PVC, or IMC before rising above floor.
- I. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to **1-1/4-inch (35-mm)** trade size and insulated throat metal bushings on **1-1/2-inch (41-mm)** trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Surface Raceways:
1. Install surface raceway with a minimum **2-inch (50-mm)** radius control at bend points.
  2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding **48 inches (1200 mm)** and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

- Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- R. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed **30 deg F (17 deg C)** and that has straight-run length that exceeds **25 feet (7.6 m)**.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: **125 deg F (70 deg C)** temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: **155 deg F (86 deg C)** temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: **125 deg F (70 deg C)** temperature change.
    - d. Attics: **135 deg F (75 deg C)** temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least **0.00041 inch per foot of length of straight run per degree F (0.06 mm per meter of length of straight run per degree C)** of temperature change for PVC conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of **72 inches (1830 mm)** of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

- W. Locate boxes so that cover or plate will not span different building finishes.
- X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- Z. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.4 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION

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## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

#### 1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

### PART 2 - PRODUCTS

#### 2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
1. Black letters on an orange field .
  2. Legend: Indicate voltage and system or service type.

- C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

## 2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
  - 1. Black letters on an orange field .
  - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; **2 inches (50 mm)** wide; compounded for outdoor use.
- E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of **200 deg F (93 deg C)**. Comply with UL 224.

## 2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, **3-mil- (0.08-mm-)** thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.
- D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of **200 deg F (93 deg C)**. Comply with UL 224.
- E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, **2 inches (50 mm)** long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

## 2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than **3 mils (0.08 mm)** thick by **1 to 2 inches (25 to 50 mm)** wide.
- B. Self-Adhesive, Self Laminating Polyester Labels: Preprinted, **3-mil- (0.08-mm-)** thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of **200 deg F (93 deg C)**. Comply with UL 224.
- D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

## 2.5 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
  - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. **1/4-inch (6.4-mm)** grommets in corners for mounting.
  - 3. Nominal size, **7 by 10 inches (180 by 250 mm)**.
- D. Metal-Backed, Butyrate Warning Signs:
  - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with **0.0396-inch (1-mm)** galvanized-steel backing; and with colors, legend, and size required for application.
  - 2. **1/4-inch (6.4-mm)** grommets in corners for mounting.
  - 3. Nominal size, **10 by 14 inches (250 by 360 mm)**.
- E. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR **36 INCHES (915 MM)**."

## 2.6 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum **1/16 inch (1.6 mm)** thick for signs up to **20 sq. inches (129 sq. cm)** and **1/8 inch (3.2 mm)** thick for larger sizes.
  - 1. Engraved legend with black letters on white face .
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**. Overlay shall provide a weatherproof and UV-resistant seal for label.

## 2.7 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**. Overlay shall provide a weatherproof and UV-resistant seal for label.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be **3/8 inch (10 mm)**.
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be **1 inch (25 mm)**.

## 2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.



- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at **50-foot (15-m)** maximum intervals in straight runs, and at **25-foot (7.6-m)** maximum intervals in congested areas.
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at **6 to 8 inches (150 to 200 mm)** below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds **16 inches (400 mm)** overall.
- H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Install labels at **30-foot (10-m)** maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Emergency Power.
  - 2. Power.
  - 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
    - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.

- c. Colors for 480/277-V Circuits:
  - 1) Phase A: Brown.
  - 2) Phase B: Orange.
  - 3) Phase C: Yellow.
- d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of **6 inches (150 mm)** from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 1. Limit use of underground-line warning tape to direct-buried cables.
  - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- J. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage with black letters on an orange background.
  - 3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
  - a. Power transfer switches.
  - b. Controls with external control power connections.
- L. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- M. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum **3/8-inch- (10-mm-)** high letters for emergency instructions at equipment used for power transfer and load shedding .
- N. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
  1. Labeling Instructions:
    - a. Indoor Equipment: Unless otherwise indicated, provide a single line of text with **1/2-inch- (13-mm-)** high letters on **1-1/2-inch- (38-mm-)** high label; where two lines of text are required, use labels **2 inches (50 mm)** high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label Stenciled legend **4 inches (100 mm)** high.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION

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## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.

#### 1.2 ADMINISTRATIVE REQUIREMENTS

##### A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

#### 1.3 ACTION SUBMITTALS

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

##### B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

#### 1.4 INFORMATIONAL SUBMITTALS

##### A. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

##### A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

##### A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## 2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with the requirements in this Section.

## 2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  - 1. Products: Subject to compliance with requirements,:
    - a. Cooper; 5351 (single), CR5362 (duplex).
    - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).
    - d. Pass & Seymour; 5361 (single), 5362 (duplex).

## 2.4 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - 1) Single Pole:
      - 2) Cooper; AH1221.
      - 3) Hubbell; HBL1221.
      - 4) Leviton; 1221-2.
      - 5) Pass & Seymour; CSB20AC1.
    - 6) Two Pole:
      - 7) Cooper; AH1222.
      - 8) Hubbell; HBL1222.
      - 9) Leviton; 1222-2.
      - 10) Pass & Seymour; CSB20AC2.
    - 11) Three Way:

- 12) Cooper; AH1223.
- 13) Hubbell; HBL1223.
- 14) Leviton; 1223-2.
- 15) Pass & Seymour; CSB20AC3.

- C. Toggle Switches, Square Face, 120/277 V, 15 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 7621 (single pole), 7623 (three way).
    - b. Hubbell; DS115 (single pole), DS315 (three way).
    - c. Leviton; 56291-2 (single pole), 5623-2 (three way).
    - d. Pass & Seymour; 2621 (single pole), 2623 (three way).

## 2.5 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: As selected by Architect ~~0.04-inch- (1-mm-)~~ ~~0.05-inch- (1.2-mm-)~~ or ~~0.04-inch- (1-mm-)~~.
  3. Material for Unfinished Spaces: Galvanized steel, high-impact.
  4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, thermoplastic with lockable cover.

## 2.6 FINISHES

- A. Device Color:
1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
  2. Wiring Devices Connected to Emergency Power System: Red .
- B. Wall Plate Color: For plastic covers, match device color.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
5. Use a torque screwdriver when a torque is recommended or required by manufacturer.
6. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
7. Tighten unused terminal screws on the device.
8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of service poles to suit arrangement of partitions and furnishings.



### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test Instruments: Use instruments that comply with UL 1436.
  - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
  
- B. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
  
- C. Wiring device will be considered defective if it does not pass tests and inspections.
  
- D. Prepare test and inspection reports.

END OF SECTION

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## SECTION 265100 - INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Interior lighting fixtures, lamps, and ballasts.
  - 2. Lighting fixture supports.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

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

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

#### 2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- G. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least **0.125 inch (3.175 mm)** minimum unless otherwise indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
- H. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Section 233713 "Diffusers, Registers, and Grilles."
  - 1. Air-Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
  - 2. Heat-Removal Units: Air path leads through lamp cavity.
  - 3. Combination Heat-Removal and Air-Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air-supply units.
  - 4. Dampers: Operable from outside fixture for control of return-air volume.
  - 5. Static Fixture: Air-supply slots are blanked off, and fixture appearance matches active units.

## 2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. General Requirements for Electronic Ballasts:
  - 1. Comply with UL 935 and with ANSI C82.11.
  - 2. Designed for type and quantity of lamps served.
  - 3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
  - 4. Sound Rating: Class A.
  - 5. Total Harmonic Distortion Rating: Less than 20 percent.
  - 6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  - 7. Operating Frequency: 42 kHz or higher.
  - 8. Lamp Current Crest Factor: 1.7 or less.
  - 9. BF: 0.88 or higher.

10. Power Factor: 0.95 or higher.

- B. luminaires controlled by occupancy sensors shall have programmed-start ballasts.
- C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
  - 1. Ballast Manufacturer Certification: Indicated by label.
- D. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

## 2.4 FLUORESCENT LAMPS

- A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.
- B. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.
  - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
  - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
  - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
  - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
  - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
  - 6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
  - 7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

## 2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm) .
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).
- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

#### 3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION