Smithsonian Institution

Office of Planning, Design & Construction

SPECIFICATIONS

PROJECT NO.: 1909101

PROJECT TITLE: FREER/SACKLER/AFA/QUAD ESS Modernization – Phase 1

FACILITY: FREER/SACKLER/AFA/QUAD

DATE: 04/08/2022

This project is approved as being in conformance with applicable provisions of the Smithsonian Directive (SD) 410.

Michael J. Carrancho, P.E., Deputy Director — Date 6/2/22

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PART 1 - PROJECT SUMMARY AND INFORMATION

1.1 PROJECT INFORMATION

A. SF Project No. 1909101

1. Freer/Sackler/AFA/Quad ESS Modernization
2. SI Quadrangle
3. Independence Ave, SW
4. Washington, DC 20560

B. Smithsonian Institution Contacts:

1. Contracting Officer (CO), address for Fed Ex, USPS and UPS delivery:
   Smithsonian Institution
   Office of Contracting
   600 Maryland Avenue, SW
   Suite 5001
   Washington, DC 20024
2. Contracting Officer's Technical Representative (COTR), address for Fed Ex, USPS, and UPS, delivery:
   Smithsonian Institution
   Attn: ~~Jimmy Hong~~ **Megan McKay**
   Office of Planning, Design & Construction
   600 Maryland Avenue, SW
   Suite 5001
   Washington, DC 20024

1.2 SUMMARY OF WORK

A. The Contractor shall furnish all supervision, labor, materials and equipment needed to modernize the Electronic Security System at the Smithsonian Institution’s Quadrangle building located on Independence Ave. SW in Washington, DC.

B. The Work includes, but is not limited to:

1. Modernizing the Electronic Security System
2. Relocating the OPS Suite
3. Modernizing the Command Center
4. Modernizing Classrooms
5. New Guard booth

C. Critical Elements of the Work: The successful Contractor shall be fully qualified to install critical elements of the Work. Upon request of the Contracting Officer, bidders/offerors shall submit a statement of qualifications to address the following critical elements of the Work:

1. Installation of Electronic Security Systems

1.3 CONTRACT TIME FOR COMPLETION

A. Work under this contract shall begin by the Contractor within ten (10) calendar days after the Notice to Proceed (NTP) and shall be completed within the total contract time of 365 calendar days. All work, including project closeout activities, shall be completed in every respect within the contract time.

B. The start date and completion date shall be as stated in the Notice to Proceed issued by the Contracting Officer.

1.4 SCHEDULE OF OPTIONS FOR BID/PROPOSAL

A. The following is a brief statement of the Work identified for bid/proposal options. The complete description of the Work is identified elsewhere in the drawings and specifications.

1. BASE BID/PROPOSAL:
   a. Modernize Electronic Security System

1.5 SCHEDULE OF UNIT PRICES (NOT USED)

1.6 BIDDER/OFFEROR EXAMINATION OF SITE

A. Every effort has been made to indicate all work necessary to complete the project as identified. All bidders/offerors shall carefully examine the premises during the bid/offer period and satisfy themselves as to the extent, nature and location of the work, general and local conditions, particularly those bearing on transportation, disposal, handling and storage of materials, availability of labor, water, electric power, access routes, uncertainties of the weather, type of equipment and facilities needed for the successful execution of the Work.

B. Pre-Bid/Pre-Proposal Conference and Site Visit. Before the bid/proposal opening date, a scheduled pre-bid/pre-proposal conference and site visit will be announced by the Contracting Officer. The purpose of the scheduled meeting is to provide an opportunity for all bidders/offerors to review the project site. Any comments, information, or discussion during the site visit shall not modify the contract documents.

C. This project requires special arrangements for access to a non-public area. Access to the site may be restricted at times other than during the scheduled visit.

1.7 AVAILABILITY OF DOCUMENTS

A. The solicitation documents are available, at no cost to the *bidder/offeror, from the Contracting Officer.

PART 2 - SPECIAL PROJECT REQUIREMENTS

2.1 UNITS OF MEASURE

A. All fabrication and installation shall be performed in accordance with the units of measure given in the Contract Documents.

B. All Contractor and subcontractor personnel working on the site shall possess and use metric measuring equipment for all work shown in metric units. Conversion of dimensions shown on contract drawings to English units for use of non-metric measuring equipment is prohibited.

2.2 NON-PUBLIC, TENANT AND SECURED SPACES

A. Certain tenant spaces, non-public spaces, utility and equipment rooms and other areas related to or used for purposes of storage, conservation, research, curation of museum collection and artifacts or for scientific research may have restricted access.

B. The Contractor shall identify to the COTR as soon as possible, but no less than two (2) working days in advance, any occupied areas that the Contractor must access that are located outside the limits of the project site. The Contractor shall identify in writing:

1. Restricted areas to be accessed.
2. Specific reason for needing access
3. Nature of the work to be performed.
4. Date(s) and hours needed to complete construction work activity.

2.3 MUSEUM ARTIFACTS AND SCIENTIFIC RESEARCH MATERIALS

A. The handling of museum artifacts or scientific research experiments by the Contractor is strictly prohibited without written consent of the Smithsonian. The existing museum artifacts and research related materials may be moved only by authorized Smithsonian museum curatorial personnel. An offender of this clause may be subject to arrest or removal from the premises and project by Smithsonian security officers.

B. If temporary relocation of artifacts or research experiments is necessary, the Contractor shall give notice to the COTR at least five (5) working days in advance of the time relocation is needed.

C. Humidity/Temperature Controlled Spaces: The Contractor shall take care to minimize fluctuations in air conditions and quality, particularly in areas containing artifacts and storage collections and laboratories and scientific research experiments. Humidity and temperature-controlled areas require consistency of utility operation.

2.4 COMMITMENT TO SUSTAINABILITY

A. The Smithsonian Institution is a trust instrumentality of the United States (recognized as a tax-exempt organization under Section 501(c)(3) of the Internal Revenue Code) and although not an Executive Branch of the U.S. Government, is committed to planning, designing, constructing, maintaining and operating its owned and leased buildings and facilities consistent with Federal environmental and energy management requirements, as listed in the Smithsonian OFEO Codes, Standards and Guidelines document, dated February 15, 2012, to the maximum extent practical.

2.5 COMMISSIONING

A. The Smithsonian requires Fundamental Commissioning (as defined by the LEED NC and CI rating systems) of all eligible design and construction projects, even if the project is not eligible to pursue LEED certification. The Smithsonian additionally requires Enhanced Commissioning (as defined by the LEED NC and CI rating systems) for larger projects and projects pursuing LEED certification, based on the size and complexity of the project.

PART 3 - CONTRACTOR USE OF PREMISES

3.1 HOURS OF WORK, WORKDAYS AND GOVERNMENT HOLIDAYS

A. Work shall be performed, under this contract, during the normal workdays of Monday through Friday, except Smithsonian holidays as specified herein and the normal work hours of 7:00 AM to 3:30 PM.

B. For each occasion the Contractor intends to work on Saturdays, Sundays or Smithsonian holidays or during hours other than those indicated above, the Contractor shall obtain written permission from the COTR, at least three (3) working days in advance.

C. The Contractor shall reimburse the Smithsonian Institution for security and inspection services provided by the Smithsonian when the Contractor chooses to work outside the normal workdays and hours, as identified herein. However, the Contractor will not be charged for SI overtime security and inspection services, if in the opinion of the COTR, the work cannot be done during the normal workdays and hours due to requirements of the Smithsonian.

D. Smithsonian Holidays: For holidays that fall on Saturday, the Smithsonian Holiday is observed on the previous Friday. For holidays that fall on Sunday, the Smithsonian holiday is observed on the following Monday. The Smithsonian Holidays are listed below.

New Year's Day	January 1
Martin Luther King Jr.'s Birthday	January, third Monday
George Washington's Birthday	February, third Monday
Memorial Day	May, last Monday
Independence Day	July 4
Labor Day	September, first Monday
Columbus Day	October, second Monday
Veterans' Day	November 11
Thanksgiving Day	November, fourth Thursday
Christmas Day	December 25
President's Inauguration Day	*January 20, 2025

3.2 CONDITIONS AFFECTING CONTRACTOR'S WORK

A. Existing Occupied Spaces: The premises will be occupied during the performance of the Work. The Contractor shall schedule work activities to minimize interruption of occupants and occupied spaces. Efforts will be made to temporarily move employees and contents out of specific areas under construction, as needed, during the times requested by the Contractor. However, the needs of the Smithsonian Institution take precedence and free access for the Contractor cannot always be guaranteed.

B. Relocation of Existing Occupants: Contractor's requests for the Smithsonian to temporarily relocate existing occupants or for Contractor's access to secured areas shall be made to the COTR as far in advance as possible, but no less than three working days in advance of the need for relocation.

C. Space for Contractor Use: The space available for Contractor's use is limited to areas indicated on the Contract Drawings as the project site. Space allocation and availability are subject to change, at the discretion of the Smithsonian, to meet the needs of all parties requiring access and space within the building and the surrounding areas.

3.3 CONTRACTOR DELIVERIES, HAULING AND ACCESS

A. The Contractor's materials and equipment shall be delivered, received and handled by the Contractor's personnel.

B. Access to the building for on- and off-loading of all material, structures and equipment shall be made between the hours of 6:00 a.m. and 3:00 p.m.

C. The Contractor may use the freight elevator for movement of material, structures and equipment within acceptable loading limits.

D. All hazardous materials shall be transported through the building in secondary containment and properly secured to transport carts to prevent breakage or spills. Consult with COTR on routes for transporting.

3.4 DRESS AND DEPORTMENT

A. Contractors' personnel shall be fully and appropriately clothed at all times and shall conduct themselves in a manner appropriate to a public place. The COTR may require removal of any individual from the premises and project for unacceptable dress, demeanor or disruptive conduct, if the Contractor superintendent fails to correct conditions in violation of this paragraph.

3.5 CONTRACTOR PARKING

A. There is no onsite parking at the site for the duration of the project.

3.6 EATING, DRINKING, SMOKING, AND ILLEGAL SUBSTANCE ABUSE

A. Eating and drinking in Smithsonian buildings or leased space will be allowed only in designated areas. Offenders may be subject to removal from the premises and project should the Contractor's Superintendent fail to correct conditions, which, in the opinion of the COTR, violate this clause.

B. The consumption of alcoholic beverages by the Contractor's personnel is prohibited in all Smithsonian buildings or leased space.

C. Vaping, using E-cigarettes and Smoking or carrying lighted tobacco products is prohibited in all Smithsonian buildings or leased space, in exhibition and public spaces, in areas where hazardous materials are stored or handled and in areas undergoing construction, renovation or repair. Acceptable areas for smoking are outside of the building at least 25 feet from any opening, operable window or air intake vent and as designated by the Smithsonian Building Manager.

D. The possession, sale and/or use of narcotics or other illegal substances or firearms by Contractor employees are strictly prohibited in all Smithsonian facilities and leased space. Contractor employees are strictly prohibited from working on the project under the influence of alcohol and/or illegal substances. Contractor employees in violation of any of the above prohibitions will be removed from the project.

PART 4 - PROJECT COORDINATION

4.1 COORDINATION OF TRADES

A. The Contractor shall coordinate work of different trades so that interference between mechanical, electrical, architectural and structural work, including existing services, shall be avoided.

B. Where work by separate entities requires off-site fabrication of products and accurate interfacing of materials to produce the required results, the Contractor shall prepare coordination drawings to indicate how work shown on separate shop drawings will be interfaced, intermeshed and sequenced for installation. Coordination drawings shall be submitted in accordance with the requirements of the "Submissions" section.

1. Work installed prior to approval of coordination drawings shall be at the Contractor's risk. Subsequent relocations required to avoid interferences shall be made without additional expense to the Smithsonian. If an interference develops, the COTR will decide which work shall be relocated, regardless of which was installed first.

C. Installation of equipment and systems shall allow the maximum practical space for operation, repair, removal and testing, within the limits indicated on the Contract Documents. Pipes, conduit, ducts and other system components shall be installed as close as possible to ceiling slabs, walls and columns to minimize space used while accommodating function and maintenance.

4.2 QUALITY CONTROL

A. The Contractor shall provide for quality control, inspections, testing and re-testing as necessary for all work, including that of Subcontractors, to assure compliance with the contract documents.

B. Contractor Quality Control (CQC) System: The Contractor shall provide a quality control organization and system to perform quality control, inspections, testing and re-testing as necessary for any item of work, including that of Subcontractors, to assure compliance with the contract documents.

C. CQC Representative Designation and Authority: The Contractor shall provide a CQC Representative, supplemented as necessary by additional personnel, who shall be on the jobsite at all times during progress, with complete authority to take any action necessary to ensure compliance with the contract documents. The CQC Representative shall be appointed by a letter addressed to him/her and signed by an officer of the firm and shall not be the same individual as, or be subordinate to, the job superintendent or project manager.

D. CQC Plan Requirements: The Contractor shall submit for review/approval a CQC Plan within thirty (30) calendar days after Contract Award to the COTR for approval. The Plan shall detail the procedures, instruction and reports to be used to assure compliance with the contract documents. As a minimum, the Plan shall include the following:

1. Designation of the CQC Representative: Identify the person and list duties, responsibilities and authority.
2. Organization Chart: Show CQC staff and its relationship with other staff members and Subcontractors.
3. Personnel Matrix: For each specification section, identify who is the authorized submittal reviewer, who will inspect the work, what testing laboratory or person will perform on-site testing, who will perform factory inspections and testing and who will certify the documentation.
4. Responsibility and Authority: State the responsibility and authority for each individual in the CQC system.
5. Personnel Qualifications: Provide resumes and descriptions of prior experience on similar work.
6. Inspection Procedures and Schedule: Identify the inspection and testing procedures and scheduled dates as reflected on the CPM project schedule, organized by technical specification section.
7. Submittal Review Procedures and Schedule: Provide submittal log in accordance with the Submissions section. For each specification section, identify the name(s) of person(s) authorized to review and sign submittals for compliance.
8. CQC Documentation: Identify the procedures for documenting quality control operations, inspection and testing. Provide samples of each type of required documentation - all forms, logs, reports, etc. Include a testing log listing all tests and inspections required by the contract documents and stating the action to be taken by the Contractor and/or the Smithsonian.

E. CQC Staffing Requirements: The following listing of minimum staff requirements in no way relieves the Contractor of meeting the basic requirements of the Contractor Quality Control System for this project. The Contractor shall ensure an adequate staff to meet the CQC requirements at all times during construction. When necessary for a proper CQC organization, the Contractor shall provide additional staff at no cost to the Smithsonian.

1. CQC Representative: The CQC Representative shall be a graduate engineer or architect with a minimum of seven (7) years of construction experience on projects similar to this one, including three (3) years experience in Quality Control.
2. Alternate CQC Representative: The Contractor shall designate an alternate person to act for the CQC Representative in case the CQC Representative is absent from the construction site. The alternate may not act for the CQC Representative for a period longer than fourteen (14) consecutive calendar days without written approval by the COTR.
3. CQC Submittals Assistant: The Contractor shall assign an assistant, to work until submittals are 95% complete, whose sole duty shall be to assist the CQC Representative in maintaining files and logs for submittals.
4. CQC Specialized Supplemental Personnel: The Contractor shall provide, as a minimum, a different person in each of the areas listed below to assist and report to the CQC Representative. Supplemental personnel shall be responsible for ensuring that the construction complies with the contract documents in their areas of responsibility. They shall be on the jobsite during all installation and testing in their areas of responsibility and shall be responsible for performing inspections and witnessing testing as required by the contract documents.

F. CQC Inspection Requirements: As a minimum, the inspection procedures shall include the following:

1. Preparatory Inspection: Preparatory inspection shall be performed before beginning work and before beginning each segment of work. Preparatory inspection shall include a review of the contract requirements, complete review of shop drawings and other submittals for conformance with contract documents, confirmation that all required testing will be provided, physical examination of all materials and equipment for conformance with approved shop drawings and submittals and verification that all required preliminary work has been completed.
2. Initial Inspection: Initial inspection shall be performed as soon as a representative segment of the particular item of work has been accomplished. Initial inspection shall include checking of all dimensions, careful inspection of workmanship, and performance of required testing, performance of corrective actions as necessary and approval or rejection of the initial segment of the work.
3. Follow-up Inspections: Follow-up inspections shall be performed daily or more frequently, as necessary, and shall include continued testing and examinations to assure continued compliance with the contract requirements.
4. Special Inspection and Documentation: In addition to the above inspection requirements, certain Special Inspection and Documentation requirements may be contained within the technical specification sections. Each Special Inspection shall be performed and documented as required and documentation shall be submitted as soon as possible after performance unless otherwise indicated.
5. Factory Inspection by the Contractor: The Contractor shall arrange and perform all factory inspections specifically required in the technical specifications sections.
6. Non-Compliance Check-Off List: The CQC Representative shall maintain a check-off list of work that does not comply with the contract, stating specifically what is non-complying, the date the faulty work was originally discovered and the date the work was corrected. The CQC Representative shall not allow the Contractor to add to or build upon non-complying work unless, in the opinion of the COTR, correction can be made without disturbing the continuing work. The CQC Representative shall submit a copy of the check-off list to the COTR on a monthly basis. Items corrected on the day they are discovered do not need to be included on the submitted list.
7. Completion and Inspection of Work: The CQC Representative shall sign the written request for Substantial Completion Inspection (discussed in the Project Closeout Requirements section).

G. Testing Requirements: Except as specifically stated otherwise, the Contractor shall be responsible for all field sampling and in-place testing required by the contract documents.

1. Independent Testing Laboratory: The Contractor shall provide an independent, commercial testing laboratory to perform all sampling and testing services required, unless otherwise specified. The testing services shall be on- or off-site as required. Submit complete documentation of all tests performed in connection with the construction contract.
2. Smithsonian Acceptance of Laboratories: Except for factory tests, all field sampling and testing normally performed by commercial laboratories shall be performed by an independent commercial laboratory employed by the Contractor and accepted by the COTR. The Contractor shall submit the following information to the COTR for approval:

    a. Name, registration number and engineering discipline of the Registered Professional Engineer in charge of the laboratory.
    b. Affidavit of compliance and certification that the laboratory performs work in accordance with requirements as stated in the contract documents.

c. A list of testing equipment proposed for each test procedure including latest calibration data.
d. A copy of the latest Laboratory Inspection Report by an independent agency with laboratory certification that deficiencies (if any) have been corrected.
e. Names and qualifications of persons actually performing testing and sampling. Changes in personnel shall be approved by the COTR prior to performance of work under this contract.

3. Factory Tests: Unless otherwise specified, the Contractor shall arrange for factory tests when they are required under the Contract. Certified copies of test reports showing that the materials to be incorporated into the work conform to the contract documents will be acceptable, provided they are performed by the manufacturer or by agencies or laboratories acceptable to the COTR.

4. Test Results: Test results shall cite the contract requirements, the test or analytical procedures used, the actual results and include a statement that the item tested or analyzed conforms or fails to conform to specification requirements. The cover sheet for each report shall be conspicuously stamped in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, as the case may be. All test reports shall be signed by a testing laboratory representative authorized to sign certified test reports. The Contractor shall arrange for immediate and direct delivery of the signed reports, certifications and other documentation to the COTR.

H. Documentation: The CQC shall prepare or assist with the preparation of the following documents:

1. Daily Reports: The Contractor's Daily Report, as discussed in the section Contractor Correspondence and Daily Reports, shall be signed by the CQC Representative as well as the Superintendent. The CQC Representative's signature certifies that, to the best of his or her knowledge, the report is complete and correct and that all materials, equipment and work described on the report are in compliance with the contract plans and specifications, except as noted otherwise.
2. Special Inspection and Documentation: Reports of Special Inspections shall be signed by both the CQC Representative and the CQC Specialized Supplemental Person who witnessed the test or inspection certifying compliance with the specific contract requirement.
3. As-Builts: The CQC Representative shall ensure that all requirements for as-built record drawings and specifications are met. The CQC Representative or Specialized Supplemental Personnel assigned to inspect that particular portion of work shall initial each as-built drawing or technical specification section to certify its accuracy prior to submission in accordance with the Project Close-Out Requirements section.

4.3 PERMITS, LICENSES & FEES

A. The Contractor shall obtain and pay for all applicable permits and licenses required by regulating agencies, including but not limited to: permits for pedestrian and road markings, construction fences, sidewalk cuts, utility company connections, elevator certificates, waste containers, etc.

B. The Contractor shall pay all duties, fees, taxes and other charges and give all notices necessary and incidental to the due and lawful execution of the work.

C. The Contractor shall keep the Smithsonian indemnified against all penalties and liability for breach of provisions of any national, provincial, district or city statute, ordinance or law and the regulations and by-laws of any local or other duly constituted authority, which may be applicable to the Work and with such rules and regulations of public bodies and companies.

D. Food Service Facilities: The Contractor shall comply with health and sanitation requirements for new construction of food service facilities as cited in the District of Columbia Municipal Regulations, "DCMR 23 -Alcoholic Beverages and Food," available from:

Government of the District of Columbia
Municipal Building
Documents Section
1350 E Street NW
Washington, DC 20001

4.4 UTILITY SERVICE INTERRUPTIONS AND NEW CONNECTIONS

A. Any planned interruption in utility service must be approved by and coordinated through the COTR. The Contractor shall submit a written request as far in advance of scheduled interruption as possible, but no less than two (2) full working days in advance. The Contractor shall make the necessary temporary provisions to supply continuous electrical power, HVAC space conditioning and security as required during periods when service is interrupted.

B. The Contractor's work efforts to restore service shall be continuous until the interrupted utility is back in service.

4.5 SALVAGE

A. The Smithsonian Institution assumes no responsibility for salvage value or any loss or damage to materials or structures on the site for which the Contractor may have reflected a salvage value in his or her proposal or bid.

B. Except as specifically stated in the contract documents, construction materials, equipment or other items that are to be removed and neither re-used under this contract nor reserved as property of the Smithsonian Institution shall become the property of the Contractor and shall be removed from the premises by the Contractor.

4.6 CUTTING, PATCHING AND MATCHING EXISTING WORK

A. Existing work shall be cut, drilled, altered, removed or temporarily removed and replaced as necessary for performance of work under the contract. Work that is replaced shall match similar existing work. Structural members shall not be cut or altered, except where noted on drawings, without authorization of the COTR. Work to remain in place, which is damaged or defaced during this contract shall be restored to match the conditions existing at the time of award of the contract, at no additional cost to the Smithsonian.

B. Conditions exposed by removal of existing work that do not match new finishes or align with new work shall be called to the COTR's immediate attention. Necessary corrective work directed by the COTR will be subject to adjustment provisions as stated in the General Conditions of the contract.

PART 5 - PROTECTION OF THE SITE

5.1 PROTECTION OF THE SITE

A. The Contractor shall provide adequate protection for all parts of the building, including interior and exterior surfaces, its occupants and contents and grounds wherever work under this contract is performed.

B. Plan for Protection of the Site: The Contractor shall submit a plan for protection of the site to the COTR for approval. As a minimum, the Plan shall describe:

1. Proposed method, location and construction of temporary enclosures.
2. Routes of access and egress, including those for people with disabilities.
3. Location and maintenance of emergency exits.
4. Methods of protection of existing surfaces and occupants.
5. Means of connection of temporary enclosures/surfaces to existing historic materials.

C. Erosion and Sedimentation Control (ESC) Plan: If the work under this contract involves disturbance of the site grounds, the Contractor shall prepare an Erosion and Sedimentation Control (ESC) Plan conforming to the erosion and sedimentation requirements of the most recent version of the EPA Construction General Permit OR local erosion and sedimentation control standards and codes, whichever is more stringent, and shall submit the Plan to the COTR prior to the start of construction for approval. The Plan shall describe the measures implemented to accomplish the following:

1. Prevention of loss of soil during construction by storm water runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse.
2. Prevention of sedimentation of storm sewers and receiving streams.
3. Prevention of air pollution from dust and particulate matter.

D. During construction, temporary enclosures shall be constructed to prevent unauthorized access or egress. Dust and fume barriers shall be constructed, as needed or as determined by the COTR, to seal and isolate the work area from the remainder of the interior areas while the work is in progress. Wood used for protection of the site shall be pressure-impregnated, fire-retardant. All plastic sheeting shall be fire retardant 6-mil polyethylene. Submit product data to the COTR for review and approval.

E. The Contractor shall submit information describing the proposed construction of temporary enclosures and methods of installation to the COTR for approval. Any connections to existing structures must be accomplished in such a way as to minimize disturbance of existing surfaces.

5.2 PROTECTION OF FLORA, FAUNA AND CENTRAL COMPUTER CONTROLLER IRRIGATION SYSTEM

A. Flora Protection: The Contractor is expressly prohibited from collecting plant materials on Smithsonian property.

B. The Contractor shall not store materials inside the drip-line of trees or shrubs. Prior to the start of the work on site, the Contractor shall surround trees within the project site and adjacent areas with a protective fence ("snow fence"), 1.4 m high (minimum), 300 mm outside the drip line (minimum). The protective fencing shall be constructed of heavy-duty metal posts or pressure-treated 100 mm X 100 mm wooden posts, 1 m on center, with a top and bottom stringer of 50 mm X 100 mm members. The fencing fabric shall consist of 40 mm X 13 mm slats, pressure-treated.

C. Vehicular traffic inside the drip-line of trees, on turf areas or on flowerbeds is not permitted without prior approval of the Smithsonian Gardens through the COTR. If flowerbeds must be crossed by vehicles, bridging is required. Bridging shall be 2 layers of ¾ inch exterior grade plywood or 2" x 10" or 1" protective plastic decking such as Bravo mat or equal to help prevent soil compaction of the soil in the lawn areas and flowerbeds. No parking on the turf will be permitted at any time.

D. Where aerial work is being performed above flower/shrub beds, the Contractor shall protect them with an approved protective framework installed at least 300 mm above the tops of the plant materials. The Contractor shall submit the proposed method of protection to the COTR and Smithsonian Gardens for approval. Trees and shrubs shall only be tied back with the approval of the COTR and Smithsonian Gardens.

E. Any damage to the existing irrigation systems during construction shall be repaired by the Contractor within two calendar days from when the damage occurred. All repairs to the irrigation system shall be made by a certified irrigation contractor to work on Rain Bird Maxicom computer controlled irrigation systems. Certification is required.

F. Damaged piping shall be replaced using approved materials per section Division Two, "Site Work, Irrigation Systems."

G. The Contractor shall bear all costs for repairs to the damaged irrigation system. Where the low voltage control wiring is damaged due to construction, then said wiring shall be replaced from the zone valve to controller. No splicing will be permitted.

H. Identification tape, when damaged, shall be replaced with an identification wire from valve to controller.

I. All damaged irrigation piping shall be cleared of debris prior to making the permit connections.

J. The Contractor shall bear all costs for replacement of damaged plant materials. Replacement plant materials shall meet the criteria established by the Smithsonian Gardens Division of the Office of Facilities Management and Reliability.

K. Plant material removed by the Contractor for reuse shall be balled, bagged and protected in accordance with instructions prepared by the Smithsonian Gardens.

L. Turf areas damaged during construction shall be repaired by the Contractor by rototilling a minimum depth of 6 inches, backfilled with sandy-loam topsoil. Sod shall be certified sod, none netted and a minimum of one year old. Sod shall be 90:10, consisting of a minimum of three varieties tall fescues and one Kentucky Bluegrass. Smithsonian Gardens, through the COTR, must approve the source of the sod. The Contractor shall bear all costs for these repairs. Suggested sources are:

Oakwood Sod Farm, Inc.
29307 Waller Road
Delmar, MD 21875
Phone: (410) 896-4009
Toll-Free: (800)379-8488

Collins Wharf Sod
25361 Collins Wharf Rd
Eden, MD 21822
Phone: 410-334-6676
Fax: 410-749-3815
cwsod@collinswharfsod.com

Summit Hall Sod Farm
21300 River Road
Poolesville, MD 20837-9114
Phone: 301-948-2900
Fax: 301-349-2668

M. The Contractor shall be responsible for the daily removal of trash and construction debris from turf and flower/shrub beds within the limits of construction.

N. Any plant material destroyed and/or damaged by the Contractor during construction shall be replaced with like genus and species of the same size, at no additional cost to the Smithsonian. The damaged plant materials must be replaced prior to final payment. The same applies to artifacts or furniture collection pieces. Smithsonian Gardens requires five (5) working days notice should any of the artifacts or furniture collection need to be removed to facilitate construction.

O. Any construction scaffolding on turf and planted beds must be coordinated with the Smithsonian Gardens through the COTR to ensure that its installation will not damage or destroy existing plant materials or turf area or interfere with daily maintenance of the grounds. Trees may be tied back to permit scaffolding erection, no more than 4 feet if possible. The tying back must be performed by a certified Arborist with the approval of Smithsonian Gardens and the COTR. Where scaffolding is necessary to facilitate construction, Smithsonian Gardens requires a three (3) workday notice for said work.

P. Due to structural weight limits, vehicular traffic is permitted inside the Smithsonian's Enid A. Haupt Garden only with prior approval by the COTR and Smithsonian Gardens.SI analysis assumes that a contractor will not physically disturb the existing waterproofing system for the facility and that large amounts of soils or stone not be plied up on the structure, in addition to the vehicle weights. The allowable live load on the existing structure is 100 pounds per square foot. The following load values should not be exceeded without prior SI review:

1. The first is the Gross Axle Weight Rating (GAWR) of 9,000. pounds. This is the maximum allotted load on one vehicle axle or piece of equipment axle. This includes summation of the vehicle or equipment weight, the load carried and personnel on the individual axle.
2. The second is the Gross Vehicle Weight Rating (GVWR) of 14,000. pounds. This is the maximum allotted overall vehicle weight or equipment weight that includes the summation of the total vehicle or equipment weight, the total amount of material carried and personnel weights.
3. The following is a list of common equipment models, which embody the maximum sizes of vehicle or equipment conforming to the weight ratings above:
   a. Deere Landscape Loader 210LJ
   b. Deere Tractor J165M
   c. Caterpillar Compact Wheel Loader 906H
   d. Ford Truck F350
   e. Ford Truck F450
4. Before either of the two listed load values (GAWR or GVWR) is exceeded by a truck or piece of equipment, the Office of Planning, Design and Construction (OPDC) shall be contacted for review. All cranes or lifts must also be reviewed by OPDC before using them in the area.

Q. Fauna Protection: The Contractor is prohibited from hunting, collecting or feeding animals on Smithsonian property. All food and food wrapping brought on the premises must be properly disposed of in approved containers, which are secured from animals.

R. If a generator is placed on the turf, SG must have approval of its placement. Generator shall be placed on anti-compactor boards. The generator must be placed in a drip containment basin.

S. A schedule of values for plant material is not required.

T. Topsoil: ASTM D 5268, fertile, naturally sandy loam as defined by USDA Handbook no. 18, Figure 38. It shall be natural, surface soil in a friable condition and contain less than 3% subsoil. The topsoil shall be free of hardpan material, stones and clods larger than ½ inch in diameter, sticks, tree or shrub roots, debris, toxic substances (e.g. Residual herbicides) and other material detrimental to plant growth. The area and the topsoil shall be free of plant or plant parts of undesirable plants such as, but not limited to, Bermuda grass, nut sedge, mugwort, Johnsongrass, Quackgrass, Canada Thistle or noxious weeds as set forth in the Federal Seed Act. It shall be certified free of Southern Blight.

1. Contractor shall notify COTR of location of all sources of the topsoil and furnish the COTR a certified report from the agricultural experiment station or approved agricultural laboratory of an analysis performed not more than 60 days prior to the date of submission. The topsoil shall be certified to meet the following requirements:

a. Shall be a natural, original surface soil of a sandy loam texture with a mechanical analysis of 60-65% sand, 15-25% silt and 10-15% clay.
b. Shall have at least 2%, but not more than 5%, organic matter.
c. Soil pH shall be 5.5 to pH 6.5 inclusive unless otherwise specified.
d. Soil salinity by electrical conductivity measurement shall not exceed 600 parts per million (ppm) as determined by Black, Editor "Method of Soil Analysis," Part 2, published by the American Society of Agronomy, 1965.
e. The soil nutrient level shall be greater than 100 lbs./acre of magnesium, 150 lbs./acre of phosphorous and 120 lbs./acre of potassium.

2. Agricultural limestone at not more than 5 pounds per cubic yard of top soil may be used to adjust an acidic condition provided it is well mixed in a manner, which does not destroy the structure of the soil.
3. Topsoil that has been synthesized by blending materials which individually do not meet the requirements of this specification will not be accepted even though the resulting blend meets the organic matter, mechanical analysis, pH and soluble salts requirements.
4. The COTR reserves the right to inspect and sample all topsoil at the source and at the time of delivery. These inspections will be made without cost to the Contractor.
5. Topsoil must not be delivered or handled in a frozen or muddy condition.
6. Shipment and Delivery - All soil must be approved by the COTR before delivery to the site. Any material not meeting requirements of this specification will be rejected on or after delivery.

U. Screened Leaf Mold

1. As available through Maryland Environmental Services, 2020 Industrial Drive, Annapolis, MD 21401 (301/261-8596) or approved equal, completely composted and free from all materials such as glass, paper, plastics, etc. Composted sewage sludge shall not be used.

V. Soil Mix Aggregate

1. Aggregate shall be Solite 3/8 as manufactured by Solite Corp., 2508 Chamberlayne Avenue, Richmond, VA or approved equal. Lightweight aggregate shall be expanded shale or slate expanded by the rotary kiln process. The aggregate shall meet the requirements of the American Society of Testing Materials C331-81 and C33-80.

W. Backfill

1. When existing soil is acceptable for use:Existing topsoil shall be used unless so directed otherwise by the COTR. The following mixture in accordance with the specifications herein, thoroughly mixed by volume shall be used as backfill:
   a. 6 parts existing soil
   b. 2 parts leaf mold
   c. 2 parts solite #388
2. <u>When existing soil is not acceptable for use</u>: If so determined by the COTR that the existing soil is not acceptable for use, the Contractor shall excavate all soil to a depth of 24 inches and disposed of off-site. The following backfill mixture, thoroughly mixed by volume in accordance with the specifications herein, shall replace the excavated soil:
   a. 60% sandy loam topsoil
   b. 20% Solite #388
   c. 20% Composted leaf mold

3. Backfill shall be mixed off site. If requested, backfill shall be mixed in the presence of the COTR. Backfill must be approved by the COTR before delivery to the job site.

X. Ground Limestone

1. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80% calcium carbonate equivalent with a minimum 99% passing a No. 8 (2.36 mm) sieve and a minimum 75% passing a No. 60 (250 micrometer) sieve.
   a. Provide lime in the form of dolomitic limestone.

5.3 DEBRIS CONTROL AND DAILY CLEANUP

A. The Contractor shall regularly clean up the work areas and shall, at all times, maintain the project in as neat and orderly a manner as is consistent with normal operations. Debris resulting from construction operations shall be removed from the site daily by the Contractor. The Contractor shall keep all access, haul routes and site areas free of dirt, debris and other materials resulting from construction activities.

B. Under no circumstances shall any rubbish or waste be dropped or thrown from one level of scaffolding to another or within or outside the building. Rubbish may be lowered by way of chutes, taken down on hoists or lowered in receptacles.

C. Trash receptacles: The Contractor shall provide enclosed trash receptacle(s) in quantity and size necessary to meet project needs, located as approved by the COTR. Trash receptacles shall not be placed.

D. Refer to MasterSpec (AIA) Division 01 section on Construction Waste Management and Disposal following this section 010000.

5.4 DUST AND QUALITY CONTROL

A. The Contractor will execute the Work by methods that minimize dust, vapors and gases raised by construction operations. The Contractor will utilize engineering controls and work practices to prevent airborne dust, vapors, gases and objectionable odors from dispersing into the atmosphere and from being drawn into existing air-intake louvers, ductwork and adjacent elevator shafts. A work plan of methods and means for this section shall be submitted to the COTR for review and approval.

B. Dust barriers shall be erected, where necessary, to protect adjacent areas from dust infiltration as required by the COTR. Dust barriers shall be rigid and visually opaque and shall seal the work area by affixing to the structure on all sides (i.e. ceiling, walls and floor). Wood used for dust barriers shall be pressure-impregnated, fire-retardant treated lumber. All plastic sheeting shall be fire-retardant 6-mil polyethylene. Submit product data for review and approval to the COTR.

C. Means of connection of dust barriers to existing structures shall not damage the building fabric. Details of barriers shall be submitted for approval to the COTR.

D. No open fires or burning of trash are permitted.

5.5 NOISE CONTROL

A. The Contractor shall comply with the regulations of the District of Columbia and OSHA Standards 1926.52 and 1910.95 and all other regulations relative to safety noise control.

B. Activities that generate excessive noise or vibration and interrupt museum functions or create public disturbances may be required to be performed during off-hours at the discretion of the COTR.

C. The Contractor shall provide sound attenuation to maintain acoustic level below 75 dBA at a distance of 15 m or below 75 dBA in occupied staff areas if less than 15 m away from noise source.

5.6 VERMIN, PEST AND RODENT CONTROL

A. The Contractor shall develop an Integrated Pest Management (IPM) plan and provide regularly scheduled inspection services by a licensed Pest Management Professional to manage and, when possible, to eliminate insects, rodents, birds, arachnids and other miscellaneous pests invading the project site or premises for the duration of the project. In general, preventative pesticide applications are prohibited. Preventative pesticide applications may be made when there is a surveillance-based indication of pest infestation. Such applications shall be made on a case-by-case basis and only upon written approval of the COTR prior to such application. The IPM plan must address all the specific IPM requirements listed in the Leadership for Energy and Environmental Design (LEEDTM) Existing Buildings: Operations & Maintenance Indoor Environmental Quality (IEQ) Credit for Green Cleaning: Indoor Integrated Pest Management, including preferred use of nonchemical methods, the use of least toxic pesticides as identified by San Francisco Tier 3 Low Hazard pesticides (SF Pesticide Hazard Screening List), the definition of emergency conditions (defined as a threat to landscape, building integrity or human occupancy after non-chemical methods have been exhausted) and universal notification (advance notice of not less than 72 hours under normal conditions and 24 hours in emergencies before a pesticide, other than a least toxic pesticide, is applied in a building or on surrounding grounds that the building management maintains). Any outdoor IPM plan must also be integrated with any indoor IPM plan for the building, as appropriate.

B. Throughout the term of this contract, all Contractor personnel providing on site pest control service must maintain pesticide certification(s) as a Commercial Pesticide Applicator in the appropriate EPA category (Industrial, Institutional, Structural and Health Related Pest Control).

Minimum pesticide certification is to include General Pest Control and Rodent Pest Control categories.

C. The Contractor shall describe methods and procedures to be used for identifying sites of pest harborage and access and for making objective assessments of pest population levels throughout the term of the contract.

D. The Contractor shall provide photocopies of state-issued Commercial Pesticide Applicator certificates for every Contractor employee who will be performing on site pest management services under this contract, as well as current Pesticide Business Licenses for the state(s) in which these services are to be performed.

E. All employees of the Contractor performing pest control services on the site(s) specified in this solicitation shall carry with them, as required by law, their personal pesticide identification card.

F. Other employees of the Contractor who are not certified in any applicable pest control category shall, as a condition to performing pest management services under this contract, meet one of the following requirements:

1. Shall perform pest management services under the direct and immediate supervision of the Contractor's certified pesticide applicator(s).
2. Will have obtained a written waiver of this provision from the COTR based upon the employees' special qualifications and /or exigent circumstances. The COTR shall have complete discretion to approve or disapprove such waiver.

G. The Contractor shall be responsible for advising the COTR about any structural, sanitary or procedural modifications that would reduce pest food, water, harborage or access.

H. The Contractor shall obtain the approval of the COTR prior to any application of sealing materials or other structural modifications to prevent the introduction of pests into the project site or premises.

I. The Contractor shall be responsible for carrying out work according to an approved pest management plan. The Contractor shall receive concurrence of the COTR prior to implementing any subsequent changes to the approved pest management plan, including additional or replacement pesticides and on-site service personnel.

J. On occasion, the COTR may request that the Contractor perform corrective, special or emergency pest control services that occur outside routine service hours. The Contractor shall respond to all such requests within four (4) hours after receipt of the request.

K. The Contractor shall submit the following information to the COTR for approval at least ten (10) working days prior to the use of any pesticide or chemical:

1. Material Safety Data Sheets (MSDSs) for the pesticide or chemical being used.
2. Written description of each proposed type of use, targeted species and restrictions on use of the area treated during and after application.

L. The Contractor shall remove dead rodents from the premises within 24 hours. Dead rodents in inaccessible areas may be treated with dilute sodium hypochlorite, neutroleum alpha or similar disinfecting or deodorizing agent. Trapping devices are the preferred method for the control of commensal rodents. The Contractor shall be responsible for disposing of all trapped rodents and all rodent carcasses in an appropriate manner. END OF SECTION 010000.

M. The Contractor shall use the safest means to protect Smithsonian property during pest management operations. If damage to artifacts, collections or any SI property occurs, the Contractor must not attempt any remedial action. The collections manager, COTR and/or building manager must be notified immediately.

N. Pesticides that constitute an extreme hazard to the environment, such as rodenticides, shall be placed in locations not accessible to children, pets and non-target wildlife or in EPA approved "tamper-resistant" bait boxes. Tamper-resistant boxes shall be constructed of sturdy materials, have a means for locking lids and be capable of being anchored securely to prevent unauthorized efforts to move the box or to displace its contents.

O. All bait boxes shall be maintained in accordance with EPA regulations, with an emphasis on the safety of non-target organisms. The Contractor shall adhere to the following points regarding bait box policy:

1. All bait boxes shall be placed out of the general view, in locations where they will not be disturbed by routine operations.
2. The lids of all bait boxes shall be securely locked or fastened shut.
3. All bait boxes shall be securely attached or anchored to the floor, ground, wall or other immovable surface, so that the bait box cannot be picked up or moved.
4. Rodenticide bait shall always be secured in the feeding chamber of the bait box and never placed in the runway or entryways of the bait box.
5. All bait boxes shall be labeled on the inside with the Contractor's business name, address and dated by the Contractor's service specialist at the time of installation and with each service.

P. Application of rodenticide outside of buildings shall emphasize direct treatment of rodent burrows, with the application of tracking powder favored over application of anticoagulant type rodenticides.

Q. The Contractor shall minimize the use of and potential exposure to pesticide wherever possible through the use of nonchemical control methods and materials.

R. When it is determined that a pesticide must be used in order to obtain adequate control, the Contractor shall utilize the least hazardous material, most precise and species-targeted application and the minimum quantity of pesticide necessary to achieve control.

S. The Contractor shall be required to maintain an accurate, up-to-date pest activity logbook(s) to document pest sightings, pest control procedures and any communications to staff regarding IPM or pesticide use. The logbook(s) shall be kept on site and maintained on each visit by the Contractor.

T. The Contractor shall observe all pesticide safety precautions throughout the performance of this contract. All work shall be in strict accordance with all applicable Federal, State and Local safety and health regulations. Where a conflict between applicable regulations arises, the most stringent will apply.

U. The Contractor is prohibited from storing any pesticide product in the buildings specified in this contract.

V. The Contractor shall establish a complete Quality Control (QC) program to assure the requirements of the contract are provided as specified in accordance with this solicitation. The QC program shall include at least the following items:

1. Inspection System: The Contractor's quality control inspection system shall cover all the services stated in this contract. The purpose of the QC program is to detect and correct deficiencies in the quality of workmanship before the level of performance becomes unacceptable and/or the COTR identifies the deficiencies.
2. A quality control checklist shall be used in evaluating contract performance during regularly scheduled and unscheduled inspections. The checklist shall include every building or site serviced by the Contractor as well as every required task.
3. A Quality Control (QC) file shall contain a record of all inspections conducted by the Contractor and any corrective actions taken. The QC file shall be maintained throughout the term of the contract and made available to the COTR or authorized SI staff personnel, upon request.
4. The Contractor shall state the name(s) of the individual(s) responsible for performing the Quality Control (QC) inspections.

5.7 DRILLING, WELDING AND TORCH CUTTING

A. Daily Permits: When welding, torch cutting or other heating operations are to occur inside existing structures, the Contractor shall obtain a daily HOT WORK PERMIT from the Building Manager's Office. Permit must be obtained no more than 24 hours in advance, including for days following holidays, Mondays and off-hours (night) work. Reference attached Hot Work Permit form and General Instructions for required permit process. The PAI (Permit Authorizing Individual) will be available in the Building Management Office and/or throughout the Facility. Building Management Office hours are from 8am to 4pm. The permit must be posted at the job site prior to beginning the scheduled work. During the course of the Work, all existing smoke and heat detectors and sprinklers heads must remain operable. Coverings may be applied to protect them from spray coatings or other hazardous conditions only during the actual operations. Coverings must be removed immediately after the operations have concluded, but at the end of each working day at a minimum. When work produces dust or other airborne contaminants, e.g. spray painting, that could impair existing fire suppression or detection system(s) or when the system itself is otherwise impaired (drained down, etc.), the Contractor shall obtain a daily FIRE

SYSTEM IMPAIRMENT PERMIT. Fire System Impairment Permit must be obtained a minimum of 48 hours in advance. Reference attached Fire System Impairment Permit form and General Instructions.

B. Fire Watch: No welding or torch cutting shall be performed unless adequate fire protection is provided. The Contractor shall maintain a fire watch for the duration of welding, cutting and heating operations and for at least 30 minutes after the 'hot' work has stopped. A fire extinguisher (minimum 10 pounds, dry-chemical type, typical) shall be on hand when drilling, welding or cutting.

C. Use of Impact Hammers: The use of impact hammers or other equipment causing vibration, noise and dust may be harmful to collections and/or building occupants. The Contractor shall request approval from the COTR at least five (5) working days before beginning this type of work to ensure adequate time for notification of building occupants and protection of objects and collections.

D. Ventilation: The Contractor shall provide adequate ventilation to prevent air contamination or the accumulation of toxic materials. Take necessary measures to prevent welding fumes frompassive transfer to adjacent areas and from entering mechanical ventilation systems, including sealing all adjacent ducts and equipment openings with plastic. Where transfer is deemed likely or verified by the COTR, utilize local exhaust ventilation with HEPA filtration to control welding fumes. The Contractor shall submit means and methods for controlling air contamination to the COTR for review and approval.

PART 6 - TEMPORARY CONSTRUCTION FACILITIES

6.1 CONTRACTOR FIELD OFFICES

A. Not applicable.

6.2 STAGING, STORAGE AND WORK AREAS

A. The Contractor shall provide adequate storage and protection of materials and equipment delivered to the site to prevent theft, weather damage, mold infiltration, moisture damage and other physical damage.

B. Plan for Staging, Storage & Work Areas: The Contractor shall submit a drawing of areas proposed for construction operations for approval by the COTR at least five (5) working days prior to mobilization or at the Preconstruction Meeting, whichever is first. The drawing shall show buildings, utilities, temporary toilet facilities, temporary utility extensions, temporary interior walls and barriers to limit unauthorized intrusion and to control noise and dust, pedestrian walkways, vehicular access, temporary fencing, trailers, sheds, storage areas and the Contract's desired route for access and egress to the premises and to the project site.

C. All wood used for temporary, interior construction shall be pressure-impregnated with a "Dricon" treatment or an equal treatment approved by the Smithsonian Institution. All pieces must bear the UL "FR-S" stamp. Intumescent (fire-retardant) paint shall not be used. All plastic sheeting shall be fire retardant 6-mil polyethylene. Submit product data to the COTR for review and approval.

D. Fencing: The Contractor shall install a "snow fence" to define the temporary work limits for construction around exterior staging, storage and work areas at no additional cost to the Smithsonian. The snow fence shall consist of 40 mm x 13 mm slats, preservative treated, 1.2 m high with 12 gage wire and 50 mm spacing between slats, on 1.8 m steel pickets with 1.8 m on center spacing.

6.3 SANITARY FACILITIES

A. Contractors' personnel will be permitted to use designated restrooms located on the premises. If, in the opinion of the COTR, the Contractors' personnel fail to maintain acceptable dress and conduct appropriate to a public place, permission to use the public restrooms may be rescinded.

6.4 TEMPORARY UTILITY SERVICES AND EXTENSIONS

A. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations for COTR review and approval.

B. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations COTR review and approval.

6.5 SCAFFOLDING AND PLATFORMS

A. The Contractor shall erect temporary scaffolding in accordance with OSHA 29 CFR 1926.451 and ANSI A10.8. The Contractor shall provide landing platforms with stairways or ladders for proper access and egress to all work areas.

B. For all frame scaffolding greater than 4 m in height, the Contractor shall submit working drawings to the COTR a minimum of ten (10) working days in advance of scaffolding erection. Working drawings submitted by the Contractor shall be certified by a registered Professional Engineer.

C. During non-working hours, the Contractor shall close and lock the scaffolding with a physical barrier to prevent access by unauthorized persons.

6.6 PROJECT SIGNS

A. All signs, including signs identifying the Contractors, shall be submitted at least five (5) working days prior to erection for approval by the COTR. The Contractor shall maintain and relocate the signs, as necessary, during the progress of the Work. The Contractor shall remove all signs, framing and foundations at the completion of the Work.

B. Construction Site Information and Direction: Informational signs required to indicate the location of the Contractor's office and directional signs for safety, vehicular control, pedestrian right-of-ways, detours to facilities, etc. shall be furnished and installed by the Contractor as requested and approved by the COTR.

C. SI Project Identification: The Contractor shall furnish and erect two 3 m2 project identification signs at the project site within 30 calendar days after the effective date of the Notice to Proceed. The exact lettering, graphics, content and location shall be determined by the Smithsonian Institution. Requirements for sign construction include:

1. Structure, Framing and Hardware: New metal structurally adequate to withstand 80 km/h winds, braced on secure foundation. Aluminum hardware. Sign attached to posts with screws from behind the sign.

2. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 25 mm thick, standard large sizes to minimize joints.
3. Primers and Paint: Exterior quality, three coats. Colors to be selected by Smithsonian. Flat enamel. Polyurethane clear topcoat on all surfaces.
4. Lettering and Graphics: Exterior quality paint. Contrasting colors to be as selected by Smithsonian. Lettering should be sized for viewing from a minimum of 6 m. Smithsonian logo to be provided by Smithsonian.
5. Content and Layout: Smithsonian shall approve Wording and layout prior to fabrication. Minimum border at the top, bottom and sides is 100 mm. Wording may include:
    a. Facility logo, 175 mm
    b. Facility name, 75 mm caps
    c. Project title, 2 lines, and 100 mm caps
    d. "Smithsonian Institution Owner", 65 mm caps
    e. "_____ Architect," 65 mm caps
    f. "_____ Contractor," 65 mm caps

PART 7 - MEETINGS

7.1 PRECONSTRUCTION MEETING

A. A Preconstruction Meeting will be scheduled with the Contractor before any work is started at the site. As soon as possible after the Date of Award, the COTR will contact the Contractor to arrange a time, date and place for the conference. Items to be discussed at the Preconstruction Meeting include, but are not limited to:

1. Contract Time: Notice to Proceed date and Completion date;
2. Scheduling and Submittals;
3. Mobilization and Staging;
4. Access to the Premises, Haul Routes, Loading Dock;
5. Contractor Deliveries;
6. Security Requirements/List of Contractor's Personnel;
7. Emergency Procedures and Phone Numbers;
8. Protection of Site and Historic Preservation;
9. Fire Protection and Safety Requirements;
10. Utility Interruptions, Rough-in Inspections, Testing;
11. Applications for Payment;
12. Pre-Condition Survey of the Site;
13. Accessibility Requirements;
14. Sustainability Requirements;
15. Building Systems Commissioning;
16. Quality Control

7.2 PRE-CONDITION SURVEY OF THE SITE

A. After the Preconstruction Meeting and before the start of work on the site, the project site (i.e. building, its contents, grounds and equipment) shall be inspected by the Contractor, major Subcontractors, COTR and other Smithsonian Institution personnel as may be required for the purpose of verification of the existing conditions. Any damages or defective equipment will be noted at this time and this survey will serve as the basis for the establishment of the pre-contract conditions. The identification of pre-contract conditions will be jointly established by the Contractor and Smithsonian Institution.

B. Written and photographic documentation: The Contractor shall prepare a typewritten and photographic report in PDF format to identify damages or defects of materials, equipment and the site. The Contractor shall submit report electronically to the Contracting Officer and the COTR.

7.3 PROJECT MEETINGS

A. Progress Meetings: The COTR will lead regular progress meetings with an interdisciplinary integrated management team consisting of representatives of the Contractor, Smithsonian, Architect/Engineer Commissioning Provider, major Subcontractors and other critical Subcontractors and suppliers. The purposes of these meetings are to expedite the work,

coordinate and schedule the Work and coordinate the work with Smithsonian activities. Progress meetings shall be held weekly unless otherwise directed by the COTR. The time and place of the meetings will be established at the Preconstruction Meeting. The Contractor shall ensure that all required Subcontractors and suppliers attend the Progress Meetings and the COTR will ensure that all necessary SI personnel attend.

B. Special-Topic Meetings: At the discretion of the COTR, additional meetings may be scheduled to address issues of quality control, sustainability requirements, coordination between contractors on the premises, coordination with other agencies, scheduling of the work, application for payments, etc. The Contractor's staff and Subcontractors or Suppliers shall attend.

PART 8 - SUBMISSIONS

8.1 SUBMITTAL DEFINITIONS

A. Submittals are defined to include shop drawings, product data, samples and additional data required for submission to the COTR for review and approval prior to incorporation into the work.

1. Shop Drawings: Detailed drawings, schedules, diagrams and illustrations prepared specifically for this project by the Contractor or any subcontractor, manufacturer, supplier or distributor to illustrate fabrication and/or installation of a portion of the Work.
2. Schedule: A detailed tabulation of components, items or parts to be furnished for use on this project.
3. Statement: An affirmation prepared by the Contractor, the installer or manufacturer of a material, product or system, to satisfy a requirement defined in a technical section.
4. Factory Test Report: A written report of the findings of a test performed by the Contractor on an actual portion of the Work or prototype prepared for this project before it is shipped to the site.
5. Field Test Report: A written report of the findings of a test performed by the Contractor on a portion of the Work during or after installation.
6. Certificate of Compliance: A written statement, signed by an authorized official of the manufacturer of a product or system or supplier of a material attesting that the product, system or material meets the requirements of the contract documents. The certificate of compliance must be dated after the award of this Contract and must name the project and cite the specification section, paragraph and requirements, which it is intended to address.
7. Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature and catalog information illustrating a material, product or system to be installed on this project, including all data related to LEED requirements, such as recycled and regional content information, Volatile Organic Compound (VOC) product schedules, Forest Stewardship Council (FSC) chain-of-custody documentation and other documentation as requested by the COTR.
8. Color Charts: Pre-printed brochures showing the color range of a material.
9. Test Reports: Reports verifying that a material, assembly, system, process or laboratory meets requirements established in the Contract Documents. Reports shall indicate compliance by naming and describing the test method and test results. Testing must have occurred within three (3) years of the date of award of this contract.
10. Samples: Physical examples of materials, equipment, assemblies or workmanship establishing standards for evaluating finished Work.
11. Color/Texture Selection Sample: Samples of an available range of textures and/or colors of a material formed of the actual finish material over a substrate identical to that which will be used in the field.
12. Mock-up: An assembly or sample panel constructed in accordance with specifications to show construction details, finished appearance and/or performance.
13. Material Safety Data Sheets: Instructions, warnings and recommended and required handling and use procedures for individual hazardous materials published by the product manufacturer.

8.2 SUBMITTALS AND REVIEWS

A. Contractor Responsibility for Submittals: The Contractor shall provide all required submittals, by technical specification section, in accordance with the contract documents. All submittals, with the exception of mockups or samples, are to be submitted electronically in PDF format, using e-mail, the Smithsonian's I-Manage portal, or a contractor-sponsored FTP site, as directed by the COTR. The Contractor shall clearly indicate, on the submittal, that it has been reviewed by the Contractor and found to meet the project requirements. Any items submitted as substitutions shall be clearly identified as such on the submittal and the transmittal document. If shop drawings show variations from the contract documents because of standard shop practices or for other reasons, the Contractor shall provide a separate, written description of variations along with the submittal. The Contractor shall:

1. Review each submittal for conformance with requirements of the contract documents and coordination with related work.
2. Determine and verify all field measurements, required material quantities, method of assembly or erection, installation requirements and proper connection to adjoining materials installed by others.
3. Assure that all submittals use the appropriate units of measure. All drawings and technical data shall be in SI (metric) units for projects designed in SI units. Preprinted literature in other units shall be accompanied by documentation to show conformance to project requirements.
4. Transmit all required submittals for a technical specification section at the same time unless prior written waiver of this requirement has been provided by the COTR.
5. Transmit submittals to the COTR in a logical and orderly sequence in accordance with the Submittal Schedule to prevent project delays or adversely impact work by the Smithsonian Institution or other contractors.
6. Correct and resubmit submittals according to response from Smithsonian Office Oof Planning, Design & Construction.
7. Commence work on items requiring submittals only after all related submittals are reviewed and approved by the Smithsonian. All Work shall conform to approved submittals.

B. Submittal Schedule and Control Log: The Contractor shall submit, to the COTR, a schedule of work-related submittals using the Smithsonian OFEO Submittal Log form within *fourteen (14) calendar days after the effective date of the Notice to Proceed. (Submittal Log form is available on computer disk upon request.) Submittals shall be listed in the order they are scheduled to be submitted and the following information shall be given:

1. Project Name, Project Number, Contractor Name, Contract Number;
2. Technical Specification Section for each submittal;
3. Unique Submittal Number;
4. Description of item to be submitted, as listed in the specifications;
5. Date item must be submitted to the Smithsonian in order to support the project schedule;
6. Subcontractor providing submittal (in "Comments" column).

C. Quantities for Submittals: Unless otherwise noted in the technical specification, the Contractor shall deliver to the COTR:

1. Shop Drawings: Submit electronic copy of shop drawings in PDF format. Submittal will be forwarded electronically to the AE for review. After submittal review, submittal will

be returned to the Contractor electronically, in PDF format. Submit in DWG format, if requested.

2. Product Data, Test Reports, Color Charts, etc.: The Contractor will make submittals in electronic format, preferably PDF.
3. Color/Texture Samples: Submit two (2) samples, minimum size 600 mm by 600 mm, unless otherwise specified. After submittal review, one (1) sample may be retained by the Smithsonian.
4. Mock-up and Sample Installations: Unless otherwise specified, minimum size shall be as noted to complete a panel section or normal break in the work.
5. Written Text Documents, Plans and Reports: Submit electronic copy of written text documents, plans and reports in PDF format. Submittal will be forwarded electronically to the AE for review. After submittal review, submittal will be returned to the Contractor electronically, in PDF format.

D. Submittal Reviews by the Smithsonian: Reviewed submittals will be marked "Approved," "Approved as Noted," "Resubmit" or "Disapproved." Submittal approval by the Smithsonian shall not relieve the Contractor of responsibility for submittal errors, omissions or deviations from the contract documents. Approval of submissions does not constitute acceptance of substitutions except as covered under sub-paragraph entitled "Contract Requests for Substitutions."

E. Submittal Review Period: The Contractor shall transmit, to the COTR, all submittals sufficiently in advance of the time necessary for fabrication and installation to allow for review by the Smithsonian and return to the Contractor, including any time needed for correction and resubmission by the Contractor. The expected time required by the Smithsonian for review of initial submission is *14 calendar days. No extension of the Contract Time will be granted for the Contractor's failure to allow sufficient time for review and processing, including resubmission of items, which initially rejected due to improper submission or non-compliance with the Contract Documents.

F. Contractor Requests for Substitutions: Contractor requests for items identified by manufacturer, brand name, make, catalog number, etc. in the contract documents shall be submitted to the Contracting Officer for approval prior to contract award, in accordance with the General Conditions. After award of the contract, contractor requests for substitutions may be considered and accepted by the Smithsonian at the discretion of the Contracting Officer.

8.3 CRITERIA FOR PRODUCT SELECTION

A. To the greatest extent possible, subject to the restrictions of the Buy American Act, provide products, materials or equipment of a singular generic kind from a single source. Where more than one choice of a product or material is available for Contractor's selection, select an option, which is compatible with other products and materials already selected.

B. Provide products complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation for intended use and effect.

C. Products, which, by nature of their application, are likely to be needed at a later date for maintenance and repair or replacement work, shall be current models for which replacement parts are available.

D. Product selection shall be done in accordance with the following requirements:

1. Standards, Codes and Regulations: Select from among products that are in compliance with the project requirements, as well as with construction standards, all applicable codes and regulations and LEED requirements.
2. Performance Requirements: Provide products that comply with specific performances indicated and are recommended by the manufacturer (in published product literature or by individual certification) for the application indicated.
3. Prescriptive Requirements: Provide products that have been produced in accordance with prescriptive requirements, using specified ingredients and components and complying with specified requirements for mixing, fabricating, curing, finishing, testing and other operations in the manufacturing process.
4. Visual Matching: Where matching with an established sample for color, pattern and/or texture, the COTR shall determine whether a proposed product matches the sample.
5. Avoidance of banned materials: The Contractor will commit to not using the following toxic and hazardous materials:
    a. Products containing asbestos, urea formaldehyde, polychlorinated biphenyls (PCBs) and/or chlorinated fluorocarbons;
    b. Products containing lead content, including older or flux containing more than 0.2 percent lead; domestic water pipe or pipe fittings containing more than 8 percent lead; and paint containing more than 0.06 percent lead.

8.4 PROGRESS PHOTOGRAPHS

A. The Contractor shall provide photographs of the project site and construction activities throughout the progress of the Work, produced by a commercial photographer, acceptable to the Smithsonian Institution. The COTR shall determine the vantage points from which photographs will be taken.

B. At least 24 color progress photographs shall be taken monthly. The actual number and location of views shall be directed by the COTR. Photographs shall be taken at the start and finish of various elements of construction designated by the COTR.

C. Within ten (10) working days of taking photographs, the Contractor shall submit to the COTR, via email or other electronic means, JPEG files for all photographs taken. The COTR will select twelve (12) images for electronic “prints”to be made. Prints may be in JPEG or PDF format.

8.5 CONTRACTOR CORRESPONDENCE AND DAILY REPORTS

A. The Contractor shall correspond with the COTR for all matters related to this construction project, unless otherwise directed. All correspondence shall be signed and dated by the Contractor and shall reference the project, project number and contract number.

B. The Contractor shall maintain daily reports using the Smithsonian Institution Contractor's Daily Report form. Reports shall be numbered consecutively and all sections shall be completed or noted as "not applicable." Reports shall contain detailed remarks each day, including but not limited to progress on the job, problems discovered and discussions with Smithsonian staff. Reports shall be submitted to the COTR each day for the previous workday.

C. All correspondence with the Smithsonian Institution shall be in the English language.

PART 9 - SAFETY, HEALTH AND FIRE PROTECTION

9.1 JOBSITE SAFETY

A. Safety Coordinator: The Contractor shall designate a person responsible for safety at the project site for the duration of the project.

B. Jobsite Safety Plan: The Contractor shall submit a Jobsite Safety Plan within *30 calendar days of the Contract Award and at least *10 calendar days prior to mobilization to the site for approval by the COTR. As a minimum, the plan shall detail the procedures, designated persons, instructions and reports to be used to assure jobsite safety for all contractors, subcontractors, Smithsonian personnel, the public and others on the site.

C. Occupational Safety and Health: This contract is subject to Title 29 of the Code of Federal Regulations, Part 1910 "Occupational Safety and Health Standards" and Part 1926 "Safety and Health Regulations for Construction" pursuant to the Occupational Safety and Health Act (OSHA) of 1970 administered by the US Department of Labor, Occupational Safety and Health Administration.

D. Emergency Assistance: The Contractor shall post, at the site, telephone numbers for reporting emergencies, including the Smithsonian Office of Protection Services (OPS), ambulance, police, fire department, gas utility, electric utility, water/sewer utility, poison prevention aid and hazardous-waste handling. This information shall be posted in a conspicuous location within the project area prior to the start of any work at the site.

E. Safety Signs: The Contractor shall post legible accident prevention signs in construction areas in accordance with OSHA standards. Safety signs shall conform to ANSI 235.1 and 235.2 Vehicular traffic control devices, barricades and signals shall conform to ANSI D6.1.

F. Report of Accident or Illness: In the event of any accident or illness for which medical assistance is required, any criminal action or any fire, the Contractor shall notify the appropriate authority (Ambulance, Police, Fire Dept.), Smithsonian Security and the COTR.

G. Emergency Evacuation: The Contractor shall post evacuation routes and facility emergency/self-protection plans at the site, train all employees in emergency procedures and document such training. In the event of a fire, the Contractor shall immediately activate the alarm at the nearest fire alarm pull station and notify building security. Upon the activation of the audible alarm, the building will be evacuated. No personnel shall reenter the facility until security personnel signal that the building is safe.

H. Contractor Personnel to be Contacted: The Contractor shall submit a written list of emergency telephone numbers and names of persons to contact for the General Contractor superintendent and for each major sub-contractor working on the project site. The initial list shall be submitted

to the COTR at the Preconstruction Meeting. The list shall be updated and resubmitted to the COTR as needed.

9.2 TOXIC AND HAZARDOUS SUBSTANCES

A. The Contractor shall submit to the COTR for approval, at least ten (10) working days prior to their intended use, a written list of toxic and hazardous substances that will be used on the project. The Contractor shall submit a "Material Safety Data Sheet" similar to OSHA Form No. 20 for these substances to identify the following information:

1. Product Identification;
2. Hazardous Ingredients;
3. Physical Data;
4. Fire and Explosion Hazard Data;
5. Health Hazard Data;
6. Emergency and First Aid Procedures;
7. Reactivity Data;
8. Spill or Leak Procedures;
9. Special Protection Information;
10. Special Precautions;
11. Volatile Organic Compound (VOC) Content.

B. The Contractor shall monitor the use of all toxic and hazardous substances to ensure that exposure to their workers from airborne concentration of, or physical contact with, these substances does not exceed applicable regulatory worker health and safety exposure limits.

C. The Contractor shall monitor the use of all toxic and hazardous substances to ensure that exposure to Smithsonian Institution employees and visitors from airborne concentrations of, or physical contact with, these substances is maintained as low as reasonably achievable. Under no circumstances shall exposure exceed the established Short-Term Exposure Limit or 50% of the established Threshold Limit Values or Permissible Exposure Limits (whichever is less) as specified in either:

1. "Threshold Limit Values and Biological Exposure Indices" of the American Conference of Governmental Industrial Hygienists, latest revision or
2. Title 29 CFR Part 1910, Subpart Z - "Toxic and Hazardous Substances" of the Occupational Safety and Health Standards, latest revision.

D. The Contractor shall provide methods, means and facilities to prevent contamination of soil, water and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations. The removal of contaminated waste shall be in compliance with applicable laws and regulations.

E. To achieve compliance with the requirements of this section, administration or engineering controls shall first be implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or other protective measures shall be used to keep exposure of all persons within the prescribed limits. Descriptions of equipment or technical

measures to be used for this purpose must be submitted to the COTR for approval. The Contractor's requirements for compliance with all applicable Local, Federal and State regulations remain in force.

F. The SI may reject any product that poses a high risk of fire or health hazard to staff, visitors or the building, based on flammability criteria (e.g. low flashpoint) or established toxicity data (e.g. designation as a human carcinogen).

G. The Contractor shall submit, to the COTR, a list of the hazardous materials to be stored on site and the manner in which they will be stored. All containers and storage cabinets shall be approved by the COTR and labeled as to hazard and content.

H. The SI has made every effort to identify and to notify the Contractor of hazardous materials that may be encountered during the work. However, if suspected asbestos-containing material, lead-based paint or other suspected hazardous materials are encountered during demolition or other phases of the work, the work involving the suspected material shall cease and the Contractor shall notify the COTR immediately. Prior to disturbance, asbestos-containing materials are to be abated in accordance with SI Specification 028200 "Asbestos Abatement" and applicable DC and OSHA requirements. Prior to impaction, lead-based paint is to be managed in accordance with SI Specification 028300 Work Activities Impacting Lead-Containing Materials.

9.3 PERSONAL PROTECTIVE EQUIPMENT

A. Personal protective equipment for eyes, face, ears, nose, head, extremities and/or full body shall be provided, used and properly maintained by the Contractor whenever necessitated by reasons of hazards encountered in a manner capable of causing illness, injury or impairment in the function of any part of the body.

B. Persons required to use personal protective equipment shall be thoroughly trained. Training programs shall, as a minimum, meet OSHA and EPA requirements where applicable. The Contractor shall submit proof and criteria for employee training as requested.

9.4 BARRICADES, BARRIERS AND WALKWAYS

A. The Contractor shall provide safety barricades in accordance with the District of Columbia Building Code and applicable OSHA regulations. The Contractor shall also provide barricades, subject to approval by the COTR, to deter passage of persons and/or vehicles into construction areas as specified or necessary.

B. The Contractor shall install temporary barriers, in a manner satisfactory to the COTR, to contain and secure the site from unauthorized entry and to minimize the adverse affects of noise, dust and vapors generated by construction activities on surrounding areas. Barriers shall be constructed of

pressure-impregnated fire-retardant treated wood, with fire-retardant 6-mil polyethylene as necessary. Submit all product data to the COTR for review and approval.

C. If the work interferes with public or employee access to the facility or parts of the facility, as determined by the COTR, the Contractor shall provide personnel barriers and signage to create easily identifiable, accessible (to people with handicaps) walkways around the work. Signs shall be posted at decision points to prevent unnecessary travel along changed routes and to dead ends. The barriers shall be erected and dismantled in phases so that a clear route is always available. The COTR and Contractor personnel shall have access through the barriers to the work areas. The Contractor may use hardware on the barrier doors to prevent entry by unauthorized persons.

1. Interior barriers shall be of standard drywall partition construction, painted and terminated at the underside the existing ceilings. All requirements for fire protection shall be maintained.
2. Exterior barriers shall be of dimensional lumber and plywood, painted on both sides and supported to prevent overturning. Barriers shall be repainted and maintained as necessary to remain in good condition as long as they are required.

D. Unless specifically indicated otherwise, barricades, barriers and associated signs shall be removed upon completion of the Work. The Contractor shall coordinate the dismantling and removal with the COTR.

9.5 EXISTING FIRE PROTECTION SYSTEMS

A. During the course of the Work, all existing smoke and heat detectors and sprinkler heads are to remain operable to the maximum extent possible. Where specific work will or may adversely affect these devices, coverings shall be applied to protect them from dust, paint overspray or other hazardous conditions for the duration of each task. Written permission shall be obtained in advance of work from the COTR. Aqualified person shall remain on site during operations while heads are covered. Coverings must be removed immediately after the operations have concluded for that day. Damaged detectors and sprinkler heads shall be replaced immediately by the Contractor at no additional cost to the Smithsonian Institution. The Contractor shall use accepted procedures to test replaced detectors and sprinklers after installation to the satisfaction of the COTR.

PART 10 - SECURITY REQUIREMENTS

10.1 GENERAL SECURITY REQUIREMENTS

A. The Contractor and his employees must comply with security requirements imposed by the Smithsonian Institution, including any necessary security clearances. Failure to inspect the site or obtain knowledge of security regulations shall not relieve the Contractor from security requirements or from performance of any part of the work.

B. Prior to the start of work on the site, the Contractor shall submit, to the COTR for approval, a list of the names, social security numbers and addresses of all employees and subcontractor employees. The list shall identify the Prime Contractor and each subcontractor and trade. It shall be updated, as necessary, to accurately identify all workers who will be working on the site during the project.

C. The name and telephone number of the Contractor's Superintendent and authorized alternate individual who can be reached on a 24-hour basis shall be provided to the COTR at the Preconstruction Meeting.

10.2 IDENTIFICATION BADGES

A. Controlled Access: Contractor employees shall sign in and out with the security officer on a daily basis for the duration of the Contract Time. Access to the building will be granted only to Contractor employees who sign the Building Entry and Departure Register at designated entrances and who wear a Contractor Identification Badge or Day Pass in plain view for inspection. Photo identification badges with serial numbers and information about allowed access may be issued by the Smithsonian to some Contractor employees.

B. ID Processing: Contractor personnel will be issued identification badges for use while on the premises.

1. ID badges will be provided by the Smithsonian at no cost to the Contractor. Smithsonian reserves the right to not issue ID badges to those Contractor employees who fail to meet security requirements.
2. The Contractor shall submit, to the COTR, a written request for approval of each employee who will be working on site and was not on the original list. Each application must be submitted at least five (5) working days before the employee is scheduled to begin on the project.

C. ID Pickup: Contractors personnel reporting for work shall be required to sign the building entry and departure register and to exchange a driver's license or some other photo identification for the Contractor Identification Badge or Day Pass. The personal identification exchanged for the badge or pass will only be returned to its owner when the credential is returned.

D. Accountability for ID: Contractors who are issued an identification badge or day pass are strictly accountable for it and for following established access control procedures. Misuse of the credential, noncompliance with access control procedures or failure to return the ID badge or day pass upon leaving the premises shall be reported to the COTR.

E. Lost ID: If a Contractor or subcontractor employee loses an ID badge or day pass, the Contractor shall report the loss immediately to the COTR. The Contractor shall submit to the COTR, within two (2) calendar days, a written report detailing how, where and when the credential was lost. A request to the COTR for authorization of a replacement credential, if necessary, shall accompany this report. The Contractor shall bear the cost for replacement of the lost badge or pass.

F. Ownership of ID: The Contractor Identification Badge or Day Pass shall remain the property of the Smithsonian and it shall not be taken off the premises. The badge will be issued to the person it identifies when he reports to the work site for duty and it must be returned to the security guard station whenever the person it identifies leaves the premises.

10.3 SECURITY OF TEMPORARY OPENINGS

A. Any temporary opening in the building perimeter or between non-public and public interior spaces must be closed and secured with means acceptable to the COTR at the end of each workday. A clear and safe path shall be maintained at all times to allow museum visitors entrance into the museums. The Contractor shall secure his facilities and equipment during non-working times at his own expense. Authorized Smithsonian personnel shall have access to the work site.

10.4 EXISTING BUILDING ALARM SYSTEMS

A. The Contractor shall notify the COTR prior to disturbing any alarm wiring, device, system, etc. The Contractor shall coordinate planned disturbances at least two (2) working days in advance of the scheduled work. Any alarm wiring, device or system that is broken or disturbed for any reason must be reported to the Building Manager, COTR and the Building Security Control Room within three (3) minutes of the occurrence.

B. If any system or component is damaged by Contractor employees, the Smithsonian Institution Office of Protection Services will determine the procedures for repairing the damage to existing building alarm systems and who will perform the repair work. The cost to repair the system and any related overtime costs for Smithsonian personnel shall be borne by the Contractor.

10.5 SECURITY GUARD DUTY CHARGES

A. If the Contractor is required to accelerate the work in order to complete the project within the specified Contract Time or if other conditions arise as a result of the Contractor's management of the work, which require that construction be accomplished during other than the normal workdays

and hours defined for this project, the Contractor will be required to assume the cost of any additional inspection and guard services at overtime rates.

B. The current overtime hourly rate charged for each Smithsonian guard is $42.00. This rate is subject to change during the Contract Time without notice.

PART 11 - SCHEDULES AND PAYMENTS

11.1 SCHEDULES OF VALUES

A. The Contractor shall submit, to the COTR, a schedule of estimated values of all parts of the work. The breakdown of costs on the Schedule of Values shall follow the divisions used in the project specifications and shall reflect major items and groups of items shown on the Contractor's project schedule. All values shall be in US dollars.

B. Wages: The contractor shall verify wages and comply with regulated wage scales, i.e. Davis-Bacon, Service Contract Act, etc.

11.2 SCHEDULING AND PAYMENTS / BARCHART

A. Project Schedule: The Contractor shall submit to the COTR for approval a Gantt bar chart project schedule within *fourteen (14) calendar days after the date of contract award. Submit Project Schedule in both PDF format and original scheduling software format. No work shall start at the site until the project schedule has been approved by the COTR. The approved bar chart will represent a baseline schedule on which the monthly construction progress will be indicated and submitted to the COTR. The baseline project schedule shall comply with the following:

1. Weekly breakdown of work activities shall be provided, including interaction between building trades, subdivided by items of work and areas of the project. Items of work shall be grouped and subdivided according to the divisions of the Construction Specifications Institute (CSI) format.
2. The start date and completion date shall be consistent with the Contract Time established by the Contracting Officer. Any intermediate deadline dates needed to meet specific requirements for Smithsonian use of portions of the work shall be shown.
3. Project condition survey activities shall be scheduled not later than the 14th calendar day of the contract time and prior to the start of any site work.
4. Project closeout activities shall be scheduled for completion in accordance with the requirements for the Contract Time for Completion.
5. Order dates and projected delivery dates shall be shown for equipment, special devices, hardware, products or other items requiring long lead-time.
6. Required delivery dates for items to be furnished by Smithsonian and installed by the Contractor shall be shown, as well as items to be furnished and installed by Smithsonian, which will affect the Contractor's work.
7. Review periods for all submittals and time required for all necessary inspection and/or testing shall be shown.
8. Dates shall be given for ordering, delivery, installation and testing of major equipment and special materials and equipment.

B. Revisions to Baseline Schedules: The Contractor shall submit, to the COTR for approval, all revisions to the approved baseline project schedule. The Contractor shall submit a proposed revision to the schedule as necessary along with proposals for construction changes, clearly indicating modifications to the schedule based on the proposal. The Contractor shall also submit, for review and approval, any proposed changes to the schedule due to inability to accomplish the

work as planned, for any reason. Approved changes to the schedule shall be incorporated into the Project Schedule and it shall be resubmitted as necessary or as requested by the COTR.

C. Progress Behind Schedule: If it becomes apparent to the COTR that the overall progress of the project is behind the approved project schedule, then the COTR will notify the Contractor in writing. The Contractor shall submit to the COTR for approval a Recovery Schedule and Plan to describe how the Work will be accelerated to meet the Contract Time requirements in accordance with the General Conditions contract clause entitled "Commencement, Prosecution and Completion of the Work." The Recovery Schedule shall be superimposed on the approved baseline project schedule to demonstrate that proposed recovery activities will accomplish completion of the work by the approved completion date.

D. Reporting Progress and Applying for Payment: Each month, the Contractor shall apply for payment and submit a report of the actual construction progress as follows:

1. By the 25th of each month, the Contractor and the COTR shall have inspected the work to determine percentages complete for each item, projected through the end of the month. The parties shall attempt to reach agreement on each item, but if they cannot reach an agreement the COTR will determine percent complete.
2. By the last day of the month, the Contractor shall submit an Application for Payment based on the determined percentages complete for each item. The application shall be submitted in triplicate on the Smithsonian standard Application for Payment form. Each copy of the Application for Payment shall be accompanied by the following:
    a. A Progress Schedule identifying the cumulative progress superimposed on the latest revision of the approved Project Schedule. The net progress for the month and applicable dates shall be clearly indicated.
    b. A complete set of copies of certified weekly-payroll data for the period.

E. Response to Application:

1. Payment shall be made only for progress agreed upon by the COTR, performed on original Contract Work or approved modifications, in accordance with the current, approved Project Schedule. Failure to submit the Application in accordance with the specifications will prevent the processing of payments.
2. Payments will be mailed to the Contractor's address as identified in the contract documents on record with the Contracting Officer. Any changes of address or requests for wire transfer of progress payments must be made in writing, signed by the Contractor's authorized person and submitted to the Contracting Officer.

11.3 ASSIGNMENT OF CLAIMS

A. Assignment of Claims are subject to the approval of the Contracting Officer. Any Assignment of Claim or subsequent re-assignment shall meet the requirements of the General Conditions contract clause entitled "FAR 52.232-23 Assignment of Claims."

B. All documents for assignments shall be written in the English language and shall be original ink signatures of the Contractor and assignee. All monies shall be identified in US dollars.

PART 12 - PROJECT CLOSEOUT REQUIREMENTS

12.1 PROJECT CLOSEOUT

A. Definition: Project closeout is a scheduled process for fulfillment of remaining contract requirements at the end of the project in preparation for final acceptance, final payment, normal termination of contract, beneficial occupancy and establishment of the warranty period(s).

12.2 SUBSTANTIAL COMPLETION

A. Definition: The date of Substantial Completion of a project or specified part of a project is the date, as confirmed by inspection by the COTR, when the construction is at least 95% complete and ready for beneficial occupancy, so that the Smithsonian can take possession of that area or part of the work. Portions of the work that are specified to be phased for completion, areas required for Smithsonian's use prior to completion of the total project or items of work identified by the COTR as necessary for partial beneficial occupancy may be inspected for substantial completion separately from the rest of the Work.

1. The Smithsonian Institution reserves the right to occupy or install equipment in completed areas of the building prior to substantial completion provided that such occupancy does not interfere with the completion of the work. Such partial occupancy shall not constitute acceptance of any part of the work.

B. Request for Substantial Completion Inspection: The Contractor shall submit a written request to the COTR for an inspection to establish Substantial Completion status. This request shall specify areas or parts of the work to be considered and shall include a listing of all exceptions to the request, that is, items not considered to be substantially complete.

C. Submission of Operation and Maintenance Manuals: Prior to requesting Substantial Completion Inspection, the Contractor shall submit, to the COTR, three (3) sets of manuals for all systems and equipment, as specified in the technical sections of this specification. The manuals shall be bound in letter-sized, three-ring, loose-leaf binders with durable plastic covers. They shall be organized into suitable volumes of manageable size using the divisions of the Specifications as a guide. Each manual shall have a table of contents and shall be assembled to conform to the table of contents with tab sheets locating each subject. The instructions shall be legible and easy to read. Where oversize drawings are necessary, they shall be folded to be not greater than letter-size. The words "Operation and Maintenance Manual," the name and location of the project, project number, contract number, date and the name of the general contractor, shall appear on the cover. Data shall be specific to the equipment that is installed and reflect all approved changes and substitutions. Data shall also reflect any required or recommended seasonal adjustments or inspections. Include electronic copy of manual, in PDF format, on CD/DVD. Manuals shall include, as a minimum, the following data:

1. Detailed description of each system and each of its components, including layout showing piping, valves, controls and other components and including diagrams and illustrations where applicable.

2. Wiring and control diagrams with data to explain detailed operation and control of each component.
3. Control sequence describing start-up, operation and shutdown.
4. Procedures for starting, operating and shutdown.
5. Installation instructions.
6. Maintenance and overhaul instructions.
7. Lubricating schedule, including type, grade, temperature range and frequency.
8. Emergency instructions and safety precautions.
9. On-site acceptance test results for equipment installed under this contract.
10. Approved product data, shop drawings and system as-builts.
11. Copies of approved certifications and laboratory test reports (where applicable).
12. Notarized copies of warranties (originals to be provided as required by "Warranties and Guarantees").
13. Written instructions for test procedures.
14. Performance curves and rating data.
15. Parts list, including source of supply, recommended spare parts and service organization convenient to Smithsonian.
16. Name, address and telephone number of each subcontractor who installed equipment and systems, local representative for each type of equipment and each system.
17. Other pertinent data applicable to the operation and maintenance of particular systems or equipment and/or other data as specified Divisions 2 through 16 of the Specifications.

D. Other Prerequisites for Substantial Completion Inspection: The Contractor shall also complete the following prior to requesting inspection for certification of substantial completion:

1. Testing and start-up of systems.
2. Installation of all signage, including accessibility related signs, equipment instructions, identification labels and permanent directional signs.
3. Submission of spare parts, tools and surplus materials as required in technical specifications. Submit to the COTR an MSDS for each surplus material that contains toxic or hazardous substances. Surplus materials that the SI determines not to retain shall be removed and properly disposed of by the Contractor according to all applicable regulations.
4. Scheduling of training sessions for Smithsonian personnel.
5. Removal of all waste, rubbish and temporary facilities and services. Means of access to all areas of the work to be inspected by the COTR shall be maintained.
6. Disposition of samples and mock-ups not incorporated into the work.
7. Arrangement for permanent utility connections and billing responsibility transfer to Smithsonian's Office of Facilities Operations (OFO).
8. Arrangement for transfer of security responsibility for the project site and changeover of locks by Smithsonian's Office of Protection Services (OPS).
9. Hazardous Waste Disposal: Submit copies to the COTR of the following hazardous waste records for hazardous waste generated on SI property and disposed of by contract personnel.
    a. Hazardous Waste Manifests
    b. Notification and Certification Forms
    c. Material Profile Sheet or characterization
    d. Container Content Sheets
    e. Certificates of Disposal

E. Scheduling of the Substantial Completion Inspection: Within seven (7) calendar days after receipt of the Contractor's written request, the COTR will either schedule an inspection or advise the

Contractor of work that must be completed or prerequisites that must be met prior to scheduling the Substantial Completion Inspection. In that case, another written request for Substantial Completion Inspection must be submitted when all requirements have been met.

F. The Substantial Completion Inspection: The Substantial Completion Inspection will be performed by representatives of the Smithsonian Institution led by the COTR. During the inspection, the COTR will prepare a punch list of deficiencies in the work. If the punch list becomes too extensive the COTR may cancel the inspection and require additional work to be performed for a repeat inspection.

1. For satisfactory inspection results, the COTR will issue the written punch list to the Contractor as soon as possible after the inspection. Items on the punch list must be completed prior to final acceptance of the total project work.
2. For unsatisfactory inspection results, the COTR will, within three (3) calendar days, give written notice to the Contractor that the Work or portion of the Work is not substantially complete in accordance with the contract documents and therefore does not meet Substantial Completion status. Requests for re-inspection shall meet all requirements for the original request for Substantial Completion inspection.

G. Punch List: Incomplete contract requirements identified during the Substantial Completion Inspection will form an initial basis for a punch list for final acceptance. All punch list items must be completed by the Contractor within the Contract Time. If additional days are needed to complete the punch list items beyond the Contract Time, then the Contractor shall submit, prior to the end of the Contract Time, a written request to the Contracting Officer stating:

1. Items requiring additional time;
2. Amount of time needed to complete each item;
3. Reasons why the items cannot be completed by the contract completion date.

12.3 FINAL COMPLETION AND ACCEPTANCE

A. Definition: The date of final completion of a project is the date, as confirmed by inspection by the COTR, when the Work is satisfactorily completed and accepted in accordance with the contract documents, as amended and/or modified.

B. Request for Final Completion Inspection: When all items on the punch list have been corrected to the satisfaction of the COTR and additional requirements as described below have been satisfied, the Contractor shall submit a written request for Final Completion Inspection.

C. Prerequisites for Final Completion: Prior to requesting the inspection for certification of Final Completion, the Contractor shall complete the following:

1. Submission of a copy of a prior punch-list stating that each item has been completed or otherwise resolved for acceptance.
2. Provision of Instructions to Smithsonian Personnel -where instructions to Smithsonian personnel are specified in other sections, furnish, without additional expense to the Smithsonian, the services of competent instructors, who will give full instruction in the

care, adjustment and operation of the systems and equipment to designated Smithsonian employees.

a. Each instructor shall be familiar with all parts of the system on which he or she is to give instruction and shall be knowledgeable about the systems' operation and required maintenance. Factory trained instructors shall be employed wherever practical and available.

b. Unless otherwise required or approved, the instruction shall be given during the regular workweek after the equipment has been accepted and turned over to the Smithsonian for regular operation. Where significant changes or modifications in equipment are made under the terms of the contract, additional instruction shall be provided as may be necessary to acquaint the operating personnel of the changes or modifications. Unless otherwise stated, at least half of the time allocated for instruction shall be "hands-on," using the actual system installed.

c. Upon completion the Contractor shall obtain written acknowledgment from the COTR that the required instruction was completed.

3. Posting of operating instructions approved by the COTR for each system and each principal piece of equipment. Include wiring and control diagrams showing the complete layout of the entire system including equipment, piping, valves and control sequence framed under clear laminated plastic and posted where directed by the COTR. Printed or engraved operating instructions for each principal piece of equipment including start-up, proper adjustment, operating lubrication, shut-down safety precautions, procedure in the event of equipment failure and any other necessary items of instruction as recommended by the manufacturer of the unit shall be attached to or posted adjacent to the piece of equipment. Operating instructions exposed to the weather or wet or humid conditions shall be made of weather-resisting materials or shall be suitably framed and enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling. The Contractor shall coordinate the location of posted instructions with the COTR.

4. Provision of equipment demonstrations for each equipment item. The Contractor shall coordinate scheduling of all demonstrations through the COTR.

5. Submission of original warranties for all products, equipment and systems.

a. The Contractor shall assemble original warranty certificates or notarized copies of warranty certificates executed by the Contractor, Subcontractors, suppliers and manufacturers in a tab-indexed, three-ring loose-leaf binder with a durable plastic cover. Provide electronic copy, in PDF format, on CD. The table of contents shall identify the item covered, the location of the item, the date of Substantial Completion, expiration date of the warranty and the supplier, vendor and installing contractor. Duplicate notarized copies of warranties shall be provided as required by "Manuals for Operation, Maintenance and As-Built Product Data."

b. Each warranty certificate or bond shall identify the date(s) for:

1) Substantial Completion status in accordance with project closeout requirements.

2) Beginning and ending of the warranty period.

3) The Contractor shall provide any coincidental product warranty, which is available on a product incorporated in the Work, but for which the warranty is not specifically required by the contract documents.

c. Warranty of Construction: The Contractor shall warrant that the work performed under this contract conforms to the contract requirements and is free of any defect in equipment, materials, design furnished or workmanship performed by the Contractor or any subcontractor or supplier at any tier. Unless otherwise stated in the technical sections of the Specifications, the warranty of the Work shall continue

for a period of one (1) year from the date of Final Completion status. If the Smithsonian takes partial occupancy before Final Completion, then the warranty for that portion shall be in effect for a period of one (1) year beginning on the date of Substantial Completion for that portion of the Work.

6. Submission of construction progress photographs and negatives, property survey and similar final record information.
7. Arrangement for changeover locks through the COTR and Smithsonian Office of Protection Services as required for security for Smithsonian occupancy.
8. Submission of evidence of payment and transfer date of utility company accounts for those utilities previously billed to the Contractor during construction, as necessary.
9. Submission of evidence that all regulatory agency permit and code requirements have been completed and recorded, as necessary.
10. Submission of a signed, written statement that no damage has occurred to the site as documented by the pre-condition survey report.
11. Final clean up, including:
    a. Sweep and dust all surfaces and wash all finished surfaces to appear new and free of all stains, soil marks, dirt and other forms of defacement.
    b. Remove labels that are not required as permanent labels.
    c. Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing substances that are noticeable as vision-obscuring materials. Replace broken glass and damaged transparent materials.
    d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of dust stains, films and similar noticeable substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective condition.
    e. Wipe surfaces of equipment clean. Remove excess lubrication and other substances.
    f. Remove debris and surface dust from limited-access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.
    g. Wet-mop concrete and clean other hard-surface floors according to manufacturers' recommendations.
    h. Vacuum clean carpeted surfaces and similar soft surfaces.
    i. Clean plumbing fixtures to a sanitary condition, free of stains including those resulting from water exposure.
    j. Clean project site (yard and grounds) of litter and foreign substances. Sweep exterior paved areas to a broom-clean condition; remove stains, petro-chemical spills and other foreign deposits. Rake grounds, which are neither planted nor paved, to a smooth, even textured surface.

D. Inspection of the Work for Final Completion: Upon receipt of the Contractor's written notice that the work has been completed, the COTR will inspect the work to confirm Final Completion status and acceptance of the work. As soon as possible after inspection, the COTR will either provide written acknowledgment of final acceptance or advise the Contractor of work not completed or obligations not fulfilled as required for final completion and acceptance.

E. Application for Final Payment:

1. Application for Final Payment shall be submitted only after Final Acceptance has been certified in writing to the Contractor by the COTR. Application shall include final labor data and progress schedule update.

2. Final Payment will be approved when Final Acceptance has been certified and the following conditions have been met:
   a. Certification signed and submitted by the Contractor that all contract requirements, including contract modifications, have been met.
   b. Final Release of Claims submitted.
   c. Release of assignment of claims or consent of surety submitted, as necessary.
   d. All security ID badges and parking permits returned to Smithsonian.
   e. As-Built Record Drawings Submitted: During the progress of the work the Contractor shall maintain a complete and up-to-date set of record prints, open to inspection by the COTR at any time. These prints shall provide a complete and accurate as-built record of all changes to the Contract Drawings, including rerouting of runs, relocation of items or control points and all other modifications. The exact location of pipes, conduit or other features concealed underground, under concrete, in chases or above ceilings shall be shown by perpendicular dimensions from at least two available landmarks. As-built drawings shall be neatly marked with colored pencils or ink, marked "As-Built" and signed and dated by the Contractor. Upon completion of the Work and before final payment, the Contractor shall submit the following to the COTR: photographically produced as-built record drawings on 4-mil, double matte, mylar sheets, sized the same as the contract drawings; electronic copies of as-built record drawings in PDF and DWG formats.
   f. As-Built Record Survey of Underground Utilities Submitted: If outside or underground utilities are part of the work, the Contractor shall furnish, to the COTR for approval, an acceptable and accurately dimensioned survey showing location and elevation of underground storage tanks, all utility lines for water, gas, electrical, sewer, steam, etc., including valves, connections and changes in direction, as installed under the contract, within the property lines and outside the building walls. Points where utility lines emerge from the building shall be located from lot monuments. The survey shall be made to scale and must be marked "As-Built" and signed and dated by the Contractor. The Contractor shall furnish a scanned, digital copy to the COTR as well as a copy on a 3-mil, double matte, mylar sheet or sheets the same size as the contract drawings.
   g. As-Built Record Specifications Submitted: The Contractor shall submit one (1) hard copy and one digital (scanned)set of project specifications with annotations to identify any changes made during construction, referencing modification numbers, dates and originators of authorizing letters or memos and other sources of changes. The cover shall be marked "As-Built" and signed and dated by the Contractor.

   h. Close-out Conditions Text and Photographic Documentation Submitted: The Contractor shall prepare a typewritten text and photographic report of observations made during the inspections for project closeout regarding conditions of new work and adjacent items that were examined for the pre-condition survey report. Any defects shall be identified and the Contractor's operations on the defect shall be described. Within ten (10) calendar days after the Final Inspection, the Contractor shall submit the text and photographic report in PDF format to the Contracting Officer and the COTR and retain a copy of each for the Contractor’s files.

END OF SECTION 010000

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 010000 "Supplemental Conditions for Construction" for restrictions on use of the premises, Contracting Officers' Technical Representative (COTR) – occupancy requirements, and phasing requirements; cutting and patching procedures; general protection and work procedures; protection of flora, fauna, and irrigation system.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to COTR repaired, cleaned, and ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, repaired, cleaned, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

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

1.4 MATERIALS

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Smithsonian that may be uncovered during demolition remain the property of COTR.

1. Carefully salvage in a manner to prevent damage and promptly return to COTR.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference(s) at location to be determined with the Architect/Owner.

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

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For closed system equipment recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building, surrounding landscape, planting, and landscape elements in all areas impacted by work activities.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for landscape and environmental protection, for noise and dust control. Indicate proposed locations and construction of barriers and fences and extent of selective demolition activities.

D. 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 COTR's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Interior access and use of elevator and stairs.
5. Coordination of COTR's continuing occupancy of portions of existing landscape and building and of COTR's partial occupancy of completed Work.

E. Predemolition Photographs and Video: Document existing condition at each area of work and show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

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

1.8 FIELD CONDITIONS

A. Smithsonian will occupy portions of the site and building immediately adjacent to selective demolition area. Conduct selective demolition so Smithsonian's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by COTR as far as practical.

C. Notify COTR of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by COTR before start of the Work.
2. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
3. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and COTR. Hazardous materials will be removed by COTR under a separate contract.

E. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces of historic elements, including temporary protection, by 12 inches (300 mm) or more.

F. Storage or sale of removed items or materials on-site is not permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.
2. Maintain irrigation system in service during selective demolition operations.

1.9 COORDINATION

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

B. Provided the Architect/Owner a minimum of 48 hours noticed prior to any scheduled interruption of service.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by COTR. COTR does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building and site to determine whether removing any element or martial might result in structural deficiency, damage, or unplanned collapse of any portion of the landscape, structure, or adjacent structures during selective demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Preparation for Removal and Dismantling: Examine construction to be removed or dismantled to determine best methods to safely and effectively perform removal and dismantling work. Examine adjacent work to determine what protective measures are necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed or dismantled and location of utilities and services to remain that may be hidden by construction that is to be removed or dismantled.
1. Verify that affected utilities are disconnected and capped.
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing elements that will be reinstalled, reproduced, or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction and (re)installation.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services, irrigation, and mechanical/electrical systems serving areas to be moved or selectively demolished.

1. COTR will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building and site.
4. Disconnect, demolish, and remove systems, equipment, and components indicated on Drawings to be removed.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent landscape, buildings, and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied areas.
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 construction.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily provide protection and cover openings to remain.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, verify condition and contents of hidden space before starting flame-

cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

4. Maintain adequate ventilation when using cutting torches.
5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
7. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items, and prep ready for use.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to COTR.
4. Transport items to Smithsonian's storage area designated by COTR.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by 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 small sections. Using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Site Pavers: Carefully remove pavers individually by cutting at joints and lifting from site. Inventory paver locations to replace in existing pattern. Clean and prepare for reinstallation on site.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them.

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. Comply with requirements specified in Section 010000 "General Conditions for Construction."

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.

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Remove: Exposed aggregate concrete to the extent shown on the drawings.

B. Remove and Reinstall: Site pavers to extent shown on the drawings.

C. Existing to Remain:
1. Site surfaces not indicated to be removed during construction on the drawings.
2. Fixed bollard units.
3. Operable bollard units.

D. Dismantle: Bollard sleeves from existing to remain bollards as indicated on the drawings.

END OF SECTION 024119

SECTION 028200 – ASBESTOS ABATEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Perform all planning, administration, execution, and cleaning necessary to safely remove asbestos-containing or contaminated materials.

B. Approval of or acceptance by the Contracting Officer's Technical Representative (COTR) of various construction activities or methods proposed by Contractor does not constitute an assumption of liability either by the COTR or Smithsonian Institution (SI) for adequacy or adverse consequences of said activities or methods.

1.2 DESCRIPTION OF THE ABATEMENT WORK

A. The asbestos abatement shall also include, but not be limited to the following:

1. Notification to regulatory agencies
2. Regulatory permits, licenses and approvals
3. Worker health and safety program
4. Air monitoring
5. Construction of temporary containment barrier/decontamination enclosures
6. Preparation for abatement operations
7. Removal of existing asbestos-containing material
8. Transport and disposal of asbestos-containing material
9. Decontamination and cleaning
10. Application of lockdown encapsulants
11. Removal of temporary containment barrier/decontamination enclosures
12. Final job close-out

B. Summary Listing of Work Locations and Approximate Quantity: The Contractor shall review all contract documents and make a site visit to make his/her own determination about quantity values prior to applying for the required federal, state, or local permits from agencies having authority or jurisdiction.

C. Drawings and Other Information: Drawings of the project area(s) and the reference location(s) within the building may be provided upon request to assist in the Contractor's planning of the abatement work effort for protection of occupants and contents.

D. Other Work Not Included: Concurrently with this contract, the SI reserves the right to collect and analyze samples or retain an independent testing laboratory to provide supplemental sampling services. These services will in no way relieve the Contractor from compliance

liability or from providing the testing required by these specifications or any other requirements of other agencies with jurisdiction authority.

NOTE: The SI has contracted independent air monitoring and testing services. The Contractor shall use a different firm for air monitoring and testing on this project.

1.3 DEFINITIONS

A. Abatement: Procedures to control or eliminate fiber release from asbestos-containing building materials, to include encapsulation, enclosure and removal.

B. Abatement Work Area (regulated area): An area established by the employer to demarcate areas where Class I, II, III and IV asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work accumulate; and a work area within which airborne concentrations of asbestos, exceed or there is a reasonable possibility they may exceed the permissible exposure limit.

C. Airlock: A system of enclosures within the containment area consisting of two (2) doorways, curtained with polyethylene sheeting, at least 1 meter apart.

D. Air Filtration Units: A local exhaust unit, utilizing high-efficiency particulate air (HEPA) filtration and capable of maintaining a minimum negative pressure differential of 0.05 mm of water within the containment barrier with respect to that of the environment surrounding the containment barrier. The unit also cleans recirculated air or generates a constant air flow from adjacent areas into the abatement work area through the decontamination enclosure.

E. Air Monitoring: The process of measuring the fiber content of a specific volume of air during a stated period of time.

F. Air Pressure Monitoring: The process of measuring the air pressure differential between the containment barrier and the surrounding area using a micromanometer unit.

G. Amended Water: Water to which a surfactant (wetting agent) has been added to increase the ability of the liquid to penetrate asbestos containing materials (ACM).

H. ANSI: American National Standards Institute.

I. ASTM: American Society for Testing and Materials.

J. Asbestos: Asbestiform varieties of chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

K. Asbestos-Containing Material (ACM): Any material containing more than 1% asbestos by volume of any type or mixture of types.

L. Authorized Person: Any person authorized by the SI and required by work duties to be present in a regulated area.

M. Caulking: High-grade rubber base caulk for masonry and/or for other materials to be used or existing, as appropriate.

N. Class I Asbestos Work: Activities involving the removal of thermal systems insulation (TSI) and surfacing ACM and presumed asbestos containing materials (PACM).

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

P. Class III Asbestos Work: Repair and maintenance operations, where ACM, including TSI and surfacing ACM and PACM, is likely to be disturbed.

Q. Class IV Asbestos Work: Maintenance and custodial activities during which employees contact but do not disturb ACM or PACM and activities to clean up dust, waste and debris resulting from Class I, II and III activities.

R. Clean Room: An uncontaminated area or room which is part of the abatement worker/equipment decontamination enclosure, with provisions for storage of workers' or visitors' street clothing, protective equipment and uncontaminated materials and equipment. It may be used for changing clothes.

S. Competent Person: In addition to the definition in 29 CFR 1926.32 (f), one who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, as specified in 29 CFR 1926.32 (f). In addition, the competent person shall have successfully completed training for Class I, Class II, Class III, and Class IV projects meeting the criteria set forth in the EPA Model Accreditation Plan (40 CFR 763) for project designer or supervisor, and operations and maintenance training.

T. Containment Barrier: A temporary enclosure constructed with fire-retardant plastic sheeting, suitable framing, tape (as defined in 1.3.52) and other adhesives within the abatement work area. This barrier serves to confine the asbestos abatement and decontamination work, and to

contain the release of asbestos containing dust and debris through the action of pressure differential ventilation and air filtration systems. The only entrance is via the abatement worker/equipment decontamination enclosure.

U. COTR (Contracting Officer's Technical Representative): An individual representing the SI as the technical advisor to the SI's Contracting Officer. This individual may be an employee of the SI or consultant.

V. Critical Barrier: Those portions of the containment barrier which represent the minimum structural components necessary to maintain the asbestos removal area in airtight isolation from the surrounding areas. Critical barriers shall be placed at floors, windows, ventilation louvers and other openings as necessary to achieve abatement work area isolation before putting up the double-layer plastic sheeting containment enclosure within which abatement work is performed. If a temporary plastic sheeting/stud wall must be erected, it shall be treated as a critical barrier. The double-layer plastic sheeting containment enclosure shall then be erected on that wall. Wrappings on lights, control boxes, etc., do not constitute part of the critical barrier.

W. Curtained Doorway: A minimum 2-flap passageway to allow access or egress from one room to another while permitting minimal air movement between the rooms of the decontamination enclosure system. It is constructed by placing 2-3 overlapping sheets of plastic sheeting at least three feet wide over an existing or temporarily framed doorway. The sheets shall be weighted at the bottom so that they close quickly after being released.

X. Decontamination Enclosure: A series of connected rooms with curtained doorways between each room, for the decontamination of the abatement workers and equipment/materials. A decontamination enclosure contains a minimum of three (3) separate rooms (typically with airlocks located between the rooms) consisting of an equipment room, shower room, and clean room. The system is constructed of an air-tight, impermeable, temporary barrier. Framing for enclosure shall be metal or fire retardant pressure impregnated wood.

Y. Disposal Bag: A properly labeled minimum 0.15 mm thick, leak-tight plastic bag used for transporting asbestos waste from the abatement work area to an EPA-approved disposal site for ACM waste.

Z. Disturbance: Contact which releases fibers from ACM or presumed asbestos-containing material (PACM) or debris containing ACM or PACM. This term includes activities that disrupt the matrix of ACM or PACM, render ACM or PACM friable, or generate visible debris. Disturbance includes cutting away small amounts of ACM and PACM, no greater than the amount which can be contained in one standard sized glove bag (as defined in 1.3.29) or waste bag in order to access a building component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or waste bag which shall not exceed 1.52 m in length and width.

AA. Encapsulant: A material applied after the removal of ACM or to the ACM-edges of partially abated substrates which surrounds or embeds residual asbestos fibers in an adhesive matrix to prevent their release into the atmosphere. Encapsulation for purpose of final lockdown is not to be accomplished until after the project has passed final air clearance tests and the COTR has authorized removal of the containment.

BB. Enclosure: Procedures necessary to completely enclose material containing asbestos behind airtight, impermeable, permanent barriers.

CC. Equipment Room: A contaminated area or room which is part of the decontamination enclosure, with provisions for storage of contaminated clothing and equipment and cleaning supplies for decontamination of equipment. Airlocks are required at all entrances to the equipment room.

DD. EPA: United States Environmental Protection Agency.

EE. Excursion Limit: Airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air (1 f/cc), as averaged over a sampling period of thirty minutes.

FF. Fiber: A particulate form of asbestos, 5 micrometers or longer, with a length-to-width ratio of at least 3 to 1.

GG. Fixed Object: A unit of equipment or furniture in the abatement work area which cannot be removed from the abatement work area.

HH. Glove Bag: A pouch, typically constructed of a minimum 0.15 mm thick, 1.5 m x 1.5 m (maximum), transparent polyethylene or polyvinylchloride plastic, with inward projecting sleeve gloves to abate ACM in a sealed micro-environment with designated inlets for amended water and sealant application, and a HEPA filtered vacuum unit attachment. The pouch has capacity for tool storage and to hold removed ACM.

II. GFCI (Ground Fault Circuit Interrupter): A type of ground fault protection in areas where personnel are at high risk of receiving electrical shocks (for example, in damp locations); makes use of a device designed to trip at a ground current in the milliampere range, i.e., very much below currents that are normally harmful.

JJ. HEPA Filter: A High Efficiency Particulate Air (HEPA) filter capable of trapping and retaining 99.97% of all mono-dispersed particles 0.3 micrometer in diameter or larger.

KK. HEPA-Filtered Vacuum Cleaner: HEPA-filtered vacuuming equipment with a filter system capable of collecting and retaining asbestos fibers.

LL. Holding Area: A chamber between the washroom and uncontaminated area in the equipment decontamination enclosure system.

MM. Impermeable Waste-Disposal Containers: Suitable to receive and retain any asbestos-containing or contaminated material until disposal at an approved site. The containers shall be labeled in accordance with OSHA Regulation 29 CFR 1910.1001 and 29 CFR 1926.1101. Containers must be both water-tight and air-tight.

NN. Lockdown: The process of applying encapsulant as a finishing coat to abated surfaces after project has successfully passed final air clearance tests and the COTR has authorized removal of containment.

OO. Movable Object: A unit of equipment or furniture in the abatement work area which can be removed from the abatement work area.

PP. MSHA: Mine Safety and Health Administration:

QQ. Negative Exposure Assessment (NEA): A demonstration by the contractor, which complies with the criteria in OSHA 29 CFR 1926.1101(f)(2)(iii), that employee exposures during an operation are expected to be consistently below the permissible exposure limits (PELs). Such assessment is to be used to justify level of respiratory protection to be used on the job.

RR. NESHAPS: National Emissions Standard for Hazardous Air Pollutants.

SS. N.E.C.: National Electrical Code.

TT. NIOSH: National Institute for Occupational Safety and Health.

UU. OSHA: Occupational Safety and Health Administration.

VV. PACM: Presumed Asbestos-Containing Material, meaning thermal system insulation and surfacing material found in buildings constructed no later than 1980.

WW. PEL: Permissible Exposure Limit. An occupational limit of exposure to a chemical substance or physical agent.

XX. Personal Monitoring: Sampling of asbestos fiber concentrations within the breathing zone of an employee. Breathing zone is defined as a radius of 150 mm to 250 mm around the employee's head.

YY. Personal Protective Equipment: Equipment which may consist of coveralls, shoes, gloves, helmet, goggles, and respirator used for protection against asbestos exposure.

ZZ. Plastic Sheeting: Fire retardant Polyethylene sheet material of specified thickness used for protection of walls, floors, etc., and critical barriers in the abatement work area.

AAA. Protection Factor: The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of the degree of protection provided by a respirator to the wearer.

BBB. Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres and approved by NIOSH or MSHA for a specific category of use.

CCC. SI IH - Smithsonian Institution's Industrial Hygienist: An individual serving as the Smithsonian's industrial hygienist. This individual may be an employee or consultant.

DDD. Surfactant: A chemical wetting agent added to water to decrease surface tension and improve material penetration.

EEE. Tape: Glass fiber or other tape capable of sealing joints of adjacent sheets of plastic (0.15 mm polyethylene) and for attachment of plastic sheets to finished or unfinished surfaces of dissimilar materials under both dry and wet conditions, including use of amended water. Minimum tape width shall be 51 mm.

FFF. Warning Labels and Signs: As required by OSHA regulations 29 CFR 1910.1001 and 1926.58.

GGG. Waste Water Filters: Discharged liquids shall pass through a primary filter and the output shall be particles 20 microns or smaller. The secondary filter shall have output particles 5 microns or smaller.

HHH. Wet Cleaning: The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with amended water.

1.4 REGULATIONS AND REFERENCES

A. Regulations: Contractor shall comply with the most current edition of all federal, state, county, and city codes and ordinances as they apply to the location(s) in which the work is performed. Make available for review at the site one copy of all applicable federal, state, county and city regulations governing the abatement work, including but not limited to:

1. Occupational Safety and Health Administration (OSHA), U.S. Department of Labor
   a. 29 CFR 1910 (General Industry) and 29 CFR 1926 (Construction) Occupational Safety and Health Standards
   b. 29 CFR 1910.1001 and 29 CFR 1926.1101 Asbestos
   c. 29 CFR 1910.134 Respiratory Protection
   d. 29 CFR 1910.1200 Hazard Communication
2. U. S. Department of Transportation
   a. 49 CFR 171 Subchapter C, Hazardous Materials Regulations
   b. 49 CFR 172 Subchapter C, Shipping Container Specifications
3. 1.4.1.3 U.S. Environmental Protection Agency
   a. 40 CFR 763, Toxic Substances Control Act; particularly Subpart E, Asbestos Containing Materials in Schools
   b. 40 CFR 61, Sub-parts A and M, National Emission Standard for Hazardous Air Pollutants (NESHAPS)
4. District of Columbia Law Title 20 DCMR Section 800. District of Columbia Department of Health.
5. New York City Department of Environmental Protection.
6. New York State Department of Health; New York State Department of Environmental Conservation; New York State Department of Labor.
7. Virginia Department of Labor and Industry; Virginia Department of Professional and Occupational Regulation; Virginia Department of Environmental Quality.
8. Maryland Department of the Environment; Maryland Occupational Safety and Health.
9. Arizona Department of Environmental Quality.
10. Hawaii Department of Health.
11. Florida Department of Environmental Protection.
12. Massachusetts Department of Environmental Protection.
13. American National Standards Institute (ANSI), 1430 Broadway, New York, New York 10018. Telephone (212)354-3300
    a. ANSI Publication Z88.2 Practices for Respiratory Protection
14. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103. Telephone (215) 299-5400
    a. ASTM Standard P-189 Specification for Encapsulants for Friable Asbestos Containing Building Materials Proposal
15. Compressed Gas Association, Inc. New York. Pamphlet G-7 "Compressed Air for Human Respiration", Specification G-7.1 Commodity Specification for Air"
16. Canadian Standard Association (CSA), Rexdal, Ontario, Standard Z180.1, "Compressed Breathing Air".

1.5 SUBMITTALS

A. Reference Division 1, Section 01000 Supplementary Conditions for Construction, for additional requirements.

B. Contractor's Work Plan: The Contractor shall submit a Contractor's Work Plan for asbestos abatement work within 15 calendar days after contract award to the COTR for approval. Approval of the Plan is required prior to beginning abatement work. The Plan shall be on 220 mm x 280 mm paper in a binder indexed by the subjects listed below. Detail the procedures, instructions, and reports used to assure compliance with the contract documents.

1. Barchart Schedule: Provide barchart scheduling of the abatement work by daily and/or weekly increments for each abatement work area and individual decontamination enclosure system. The time line is to include all work, both on and off the job site, for the entire contract period.
2. Notices: The contractor shall notify federal, state, and local regulatory agencies in writing immediately upon contract award and a minimum of 10 days in advance of any asbestos related work. Notifications shall be made by the Contractor as required by USEPA National Emission Standards for Hazardous Air Pollutants (NESHAPS) Asbestos Regulations (40 CFR 61, Subpart M)). Submit copies of notifications and documentation to the COTR. If a project consists of multi-phases, with distinct start and stop dates, these shall be declared on the EPA Notice or individual notices shall be filed for each phase.
3. Permits and Licenses: Maintain current licenses and obtain applicable permits as required by federal and applicable state or local jurisdictions for the removal, transporting, disposal or other regulated activity relative to the abatement work of this contract. Submit copies of all state and local licenses and permits necessary to carry out the abatement work of this contract.
    a. All asbestos containing waste is to be transported by an entity maintaining a current "Industrial waste hauler permit" specifically for asbestos-containing materials, as required for transporting of waste asbestos-containing materials to a disposal site.
    b. Notices of Violations: Submit copies of all Notices of Violations issued to the contractor and its sub-contractors within the last three (3) years by federal, state, and local regulatory agencies.
4. Sequence of Work: Narrative description of the proposed sequencing of asbestos work and breakdown of abatement work areas requiring separate or individual decontamination enclosures. Include how enclosure systems will be erected and dismantled. Include how re-useable equipment will be cleaned for re-use before relocation or removal from the site. Include how waste disposal containers will be cleaned and removed from the abatement work area.
5. Abatement Work Area Layout Sketch: Layout sketch of decontamination enclosure systems and abatement work area. Describe assembly of construction, materials to be used and location of notices to be posted on the job site. Indicate which areas will be sealed off (and by what means). Show locations of facilities and equipment such as showers, lockers, storage, etc. Show locations of all filtration devices to be used, their exhaust, and calculations to determine the number of these devices needed to provide the minimum 4 air changes per hour in the abatement work area. These requirements shall be coordinated with the COTR and facility representative
6. Isolation of Abatement Work Areas: Methods to isolate/restrict access to abatement work areas. Include how access will be controlled, how building HVAC ventilation systems will be isolated from abatement area. Include how security and fire systems will be maintained within the containment. Include plans for electrical lock-out and dedicated electrical systems. These requirements shall be coordinated with the COTR and facility representatives.
7. Transportation and Disposal: Details of hauling equipment, materials and contaminated debris from inside the building. Submit written identification of licensed hauler and landfill location.
8. Personnel Organization and Responsibilities: The Contractor shall provide a list of all project personnel, both on-site and in the offices, and a statement of their responsibilities and authority for work on this project.

9. Personal Protective Equipment: Details of personal protective equipment and use, storage and maintenance at job site.
10. Posted Notices and Warning Signs: Submit copies of notices to be posted at the job site, as required by EPA and OSHA regulation for asbestos abatement activities.
11. Materials and Equipment Product Data: Submit manufacturer's literature and written information for all materials and equipment, including NFPA test report of flame resistant materials, and material safety data sheets for all chemical-content supplies. Contractor shall not change materials or equipment without approval of a new submittal to the COTR.
12. Contractor Monitoring Services: Before start of asbestos work, submit to the COTR the name of the contractor's industrial hygiene consultant and analytical laboratory for air monitoring.
13. Superintendent/Competent Person: Before start of asbestos work, submit to the COTR the name of job site supervisor who must meet the following requirements as a minimum. Furnish documentation that the General Superintendent:
    a. has a minimum of five (5) years on-the-job experience as a supervisor of asbestos abatement projects
    b. is a competent per Section 1.3.15 of this document.
    c. is certified as an Asbestos Abatement Supervisor in accordance with 40 CFR Part 763.
    d. is fluent in the English language and all other primary languages spoken by the abatement work crew.
14. Workers' Specialized Training: Submit training course descriptions, locations, and dates. Submit to the COTR a written affidavit before start of asbestos removal as proof that all employees have had instruction on the hazards of asbestos exposure; and on all aspects of work procedures and personal protection and area protective measures as required and/or recommended by OSHA and EPA and other applicable guide documents. The affidavit shall include course name, designation, installation, place, date taken, and student names.
    a. Training shall be in accordance with 29 CFR 1926.1101.
    b. Course certification shall be in accordance with EPA as required by 40 CFR 763.
    c. Workers should have a minimum of one (1) year experience as an asbestos worker.
15. Respiratory Program: Submit a written respiratory program as defined in OSHA 1926.1101 and in these specifications. Submit type of NIOSH/MSHA certified respiratory equipment intended for each operation required by this project. Selection criteria must meet 29 CFR 1926.1101 (h) (2). When a Type "C" supplied positive pressure air respiratory system is required by the abatement work, submit drawing showing assembly of components into a complete supplied air respiratory system. Include diagram showing location of compressor, filter banks, backup air supply tanks, hose line connections in abatement work area(s), routing of air lines to abatement work area(s) from compressor.
16. Negative exposure assessment data submitted to justify respiratory selection must be less than 12 months old and closely resemble the current project following criteria set forth in 29 CFR 1926.1101 (f) (2) (iii).
17. Emergency Preparedness: Submit an emergency plan to COTR for approval by SI Office of Safety, Health and Environmental Management (OSHEM). The emergency plan shall address responses to fire, accident, power failure, pressure differential system failure, supplied air system failure, or any other event that may requiremodification or abridgement of decontamination or abatement work area isolation procedures. Show exit routes from the building, locations of the nearest manual pull stations, telephone number of Smithsonian security office, name of the designated employee responsible for fire protection, fire hazards inherent to the project and measures taken for prevention. All

employees shall be familiar with the emergency plan and have initialed the plan after reading it, know how to activate the fire alarm, and trained in the use of portable fire extinguishers. One on-site employee shall be designated as responsible for fire protection. The plan shall be available at the job site in all primary languages of the abatement work crew. In addition, the following emergency information shall be posted at all entrances to the abatement work area:

a. Exit route map
b. Phone number of SI security office

1.6 DAILY REPORTS

A. The Contractor shall correspond with the COTR for all matters related to this construction project, unless otherwise directed.

B. All correspondence with the SI shall be in the English language, signed and dated by the Contractor.

C. Reference General Conditions (Construction Contract Clauses) and Specifications Division 1 for Supplementary Conditions for Construction.

D. The Contractor shall maintain daily logs and reports of job-site activities and personnel exposure monitoring at the site and shall provide copies to the COTR for inspection upon request.

E. The Contractor shall maintain daily reports using the SI Contractor's Daily Report form. Reports shall be numbered consecutively, and all sections shall be completed or noted as 'not applicable.' Each day's report shall contain detailed remarks including but not limited to progress on the job, problems discovered, and discussions with Smithsonian staff. Reports shall be submitted to the COTR each day for the previous work day. Copies shall be maintained at the jobsite and made available to the COTR upon request.

F. Reporting Unusual Events: When an event of unusual and significant nature occurs at site (examples: failure of pressure differential system, rupture of temporary enclosures, equipment or power failure, high airborne fiber reading), prepare and submit a special report listing chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information.

G. Accident Reporting: Report all accidents to Smithsonian Security Office first, then to the COTR. Prepare reports of significant accidents, at site and anywhere else work is in progress. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury is sustained, property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury. Report shall be submitted to the COTR, who will forward copies to OSHEM and the facility Safety Coordinator.

H. Waste Manifest-Asbestos: At completion of hauling and disposal of each load, submit a copy of waste manifest, chain of custody form, and landfill receipt to the COTR. Waste manifest to be submitted shall be signed by the contractor, waste transporter, and the disposal facility. A copy of all manifests will be included in the post-job submittal.

I. Waste Manifest-Hazardous Waste: Any hazardous waste generated as a result of asbestos abatement activities will be disposed of by a Certified Hazardous Waste Disposal Contractor. A copy of the Hazardous Waste Manifest generated by this disposal is to be submitted to the COTR, who will forward a copy to the facility's SI Hazardous Waste Coordinator. A copy of all manifests will be included in the post-job submittal.

1.7 PRODUCT HANDLING

A. Deliver all materials in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name.

B. Store all materials subject to damage off the ground, away from wet or damp surfaces, and under cover sufficient to prevent damage or contamination.

C. Remove from the premises all damaged or deteriorated materials. Dispose of materials that become contaminated with asbestos in accordance with applicable regulatory standards and these specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Caulking: High-grade rubber base caulk for masonry and/or for other materials.

B. Encapsulant: Product shall be rated as acceptable for use intended when field tested in accordance with ASTM Proposed Specification P-189 “Specification for Encapsulants for Friable Asbestos Containing Building Materials". Use only materials that have a flame spread index of 25 or less when dry, when tested in accordance with ASTM E-84.

C. Glove-Bag: 0.15 mm thick, 1500 mm x 1500 mm, transparent polyethylene or polyvinylchloride plastic with long sleeve gloves, designated inlets for HEPA vacuum attachment, and storage pouch.

D. Impermeable Waste-Disposal Containers: Suitable to receive and retain any asbestos-containing or contaminated material until disposal at an approved site. The containers shall be labeled in accordance with OSHA Regulation 29 CFR 1910.1001 and 29 CFR 1926.1101. Containers must be both water-tight and air-tight.

E. Plastic Sheeting: Product Standard PS 17-69 and OSHA Regulation 29 CFR 1926.1101; Polyethylene plastic sheeting material 0.15 mm thickness for covering floors and walls, providing air locks, and sealing doors and windows; supply in appropriate widths to minimize seams. Must be flame-resistant material and must meet test criteria in NFPA 701. Reinforced sheeting is required for applications subject to wear and tear.

F. Surfactant (Wetting Agent): 50% polyoxyethylene ester and 50% polyoxyethylene ether, or approved equal, shall be mixed with water to provide a concentration of 2 ml surfactant to 1 liters of water, or manufacturer's recommended concentration.

G. Tape: Glass fiber or other tape capable of sealing joints of adjacent sheets of plastic sheeting and for attachment of plastic sheets to finished or unfinished surfaces of dissimilar materials under both dry and wet conditions, including use of amended water. Minimum tape width shall be 50 mm.

H. Warning Labels and Signs: As required by OSHA regulations 29 CFR 1910.1001 and 1926.58.

I. Waste Water Filters: Discharged liquids shall pass through a primary filter and the output shall be particles 20 microns or smaller. The secondary filter shall have output particles 5 microns or smaller.

2.2 EQUIPMENT

A. Air Filtration Units: Shall be factory-sealed and equipped with HEPA filters(final), pre-filters, instrumentation to monitor pressure differential, and safety and warning devices.

1. Provide units with electrical components approved by the National Electrical Manufacturers Association (NEMA) and Underwriter's Laboratories (UL).
2. Access to the units for replacement of all air filters shall be from intake end. Provide units with pre-filters and intermediate filters installed either on or in the intake grid of the unit and held in place with special housings or clamps. The filter media shall be completely sealed on all edges with a structurally rigid frame with a continuous rubber gasket.
3. HEPA Filters: Provide units equipped with HEPA filters. Filters shall be individually tested and certified by the manufacturer.
4. Pre-filters: Provide a two-stage pre-filtration to extend the life of the primary HEPA filter. The first-stage pre-filter is a low-efficiency type effective for particles 100 micrometers and larger. The second-stage (or intermediate) filter has a medium efficiency effective for particles down to 5 micrometers.
5. Instrumentation: Provide units equipped with a magnehelic gauge or manometer to measure the pressure drop across filters and to indicate when filters have become loaded and need to be changed. A table indicating the usable air-handling capacity for various static pressure readings on the magnehelic gauge affixed near the gauge for reference, or the magnehelic reading indicating at what point the filters should be changed, noting cubic feet per minute (CFM) air delivery at that point. Provide an elapsed time meter to show the total accumulated hours of operation.
6. Safety and Warning Devices: Provide units with the following safety and warning devices:
    a. Warning lights to indicate normal operation, too high a pressure drop across the filters (i.e., filter overloading), and too low of a pressure drop (i.e., rupture in HEPA filter or obstructed discharge)
    b. GFCIs.
    c. Audible alarm if unit shuts down due to operation of safety systems.
    d. Electrical overload protection sized for the equipment. The motor, fan, fan housing, and cabinet are to be grounded.

B. Respirators and Respirator Systems

1. Product Data: Must possess NIOSH and MSHA approval for each component in an assembly and/or for entire assembly.

PART 3 - EXECUTION

3.1 CONTROLLED ACCESS TO SITE

A. Access to the abatement work area shall be restricted to contractor's workers and authorized visitors as defined in these specifications.

B. Authorized visitors shall have access to the work site at all times following notification to COTR. Contractor shall supply protective clothing and equipment for visitors as necessary, except for respirators which are to be provided by the visitor in accordance with Section 3.4 of this document.

C. Contractor shall prominently post signs at all potential entry points to the abatement work area which clearly state: "Restricted Area Under Construction-Admittance by Special Permission Only - Protective Clothing Required Beyond This Point". Immediately inside entry point and outside critical barriers post a warning sign meeting specifications of OSHA 29 CFR 1910 and 1926. Suggested format is a sign of minimum size 508 mm by 356 mm displaying the following legend:

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DANGER

ASBESTOS

CANCER AND LUNG DISEASE HAZARD

AUTHORIZED PERSONNEL ONLY

RESPIRATORS AND PROTECTIVE CLOTHING ARE

REQUIRED IN THIS AREA

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D. All workers and authorized visitors shall enter the abatement work area only through the abatement worker/equipment decontamination enclosure, in accordance with Section 3.3 of this document.

E. All workers and authorized visitors, before entering the abatement work area, shall read and be familiar with all posted regulations, personal protection requirements, and emergency procedures and exit routes.

F. Contractor shall maintain a daily job site personnel log listing names and social security numbers of individuals who entered the abatement work area, and the times of entering and leaving the area.

3.2 WORKER AND VISITOR PROTECTION

A. No eating, drinking, smoking, or chewing gum is permitted within the abatement work area. The COTR shall designate a "break area" where these activities, except for smoking, are permitted. Smoking is prohibited in SI facilities.

B. Workers and Visitors shall be fully protected with respirators and protective clothing during any work which may disturb asbestos-containing materials and result in fiber release. Full protection is not required during pre-abatement inspections of the containment, while work is not being conducted.

C. Protective Clothing and Equipment: Provide workers and visitors with sufficient sets of protective full body clothing, to include full body coveralls with hood, boots (for workers) and footwear coverings (for workers and visitors), and gloves. Provide eye protection and hard hats as required by applicable safety regulations. Contaminated non-disposal clothing and footwear shall be left in the equipment room until the end of the asbestos abatement work, at which time such items shall be disposed of as asbestos waste or shall be thoroughly cleaned of all asbestos or asbestos-containing material. Contractor shall have at least six (6) sets of disposable protective full body clothing for COTR and authorized visitors for each work day. Provide storage facilities for visitors and workers for removed street clothing in the clean room.

1. Boots: Provide workers non-skid type work boots with protective shields as required by OSHA. Paint uppers of boots with red waterproof enamel paint as a permanent marking that the boots have been exposed to ACM abatement work areas. These boots are to be handled as asbestos-contaminated materials.
2. Hard Hats: Provide hard hats that meet ANSI Z89.1 for use where work is overhead, scaffolding is being used, or as otherwise required by OSHA. Label hats with same warning labels as required for ACM disposal bags.
3. Goggles: Provide goggles that meet ANSI Z87.1 as required by OSHA.
4. Gloves: Provide disposable work gloves for use in the abatement work area.
5. Coveralls with Hood: Provide disposable coveralls with hoods for use in the abatement work area.
6. Respirators: Provide workers with personally issued and marked respirator equipment approved by NIOSH/MSHA and, in accordance with these specifications, suitable for the asbestos exposure level in the abatement work area. Where respirators with disposable filters are employed, provide sufficient filters for replacement as necessary by the abatement worker, or as required by the applicable regulation. Authorized visitors must provide their own respirators, with fresh filters or cartridges as necessary, to enter the

abatement work area. These are minimum requirements. Section 3.4 of this document is to be consulted for more detail.

3.3 ABATEMENT WORK AREA ENTRY AND EXIT PROCEDURES

A. Each time the abatement work area is entered remove all street clothes in the Clean Room of the Decontamination Enclosure and put on new disposable coveralls, new head cover, and a clean respirator. Proceed through shower room to equipment room and put on work boots.

B. Each time the abatement work area is exited, the following procedures shall be followed:

1. Before leaving the regulated area, employees and authorized visitors shall remove all gross contamination and debris from their protective clothing.
2. Personnel exiting the regulated area shall remove their protective clothing and equipment (except respirators) in the equipment room and deposit the clothing in labeled impermeable bags or containers.
3. Personnel shall remove their respirators in the shower room, washing and rinsing them.
4. Personnel shall shower thoroughly before entering the clean room.
5. After showering, employees shall enter the clean room before changing into street clothes.

3.4 RESPIRATORY PROTECTION

A. Contractor is hereby advised that asbestos has been determined by the U.S. Government to be a CANCER-CAUSING AGENT. Provide workers with respirators [which, as a minimum, meet the requirements of OSHA 29 CFR 1926.1101] and protective clothing during all phases of the abatement work and until final air tests are accepted by COTR.

B. The Contractor shall select respirators from among those jointly approved as being acceptable for protection by the MSHA and the NIOSH under the provisions of 30 CFR Part 11.

C. The Contractor shall select and provide respirators, at no cost to the employee and shall ensure that the employee uses the respirator provided.

D. Instruct and train each worker involved in asbestos abatement or maintenance and repair of asbestos-containing materials in proper respiratory use and require that each worker always wear in the abatement work area a respirator, properly fitted on the face. The respirator shall be worn from the start of any operation which may cause airborne asbestos fibers until the abatement work area is completely decontaminated.

E. Allow an individual to use only those respirators for which training and fit-testing have been provided. Require that each time an air-purifying respirator is put on it be checked for fit with a positive and negative pressure fit test in accordance with the manufacturer's instructions or ANSI Z88.2.

F. For all jobs that involve the removal of thermal system insulation (TSI) or surfacing materials (OSHA definition of Class I work) the employer shall provide respirator protection in accordance with 29 CFR 1926.1101 (h) Table 1 - Respiratory Protection for Asbestos Fibers. This level of respiratory protection shall be maintained until the employer can produce a negative exposure assessment.

G. For all other abatement work, use respiratory protection appropriate for the fiber level encountered in the abatement work area or as required for other toxic or oxygen-deficient situations encountered. The level of respiratory protection which supplies an airborne fiber level inside the respirator, at the breathing zone of the wearer, at or below the permissible exposure limit (PEL) is the minimum level of protection allowed. (Table 1, Respiratory Protection for Asbestos Fibers, 29 CFR 1926.1101) Do not use single-use, disposable, or quarter-face respirators

H. Authorized visitors are responsible for providing their own respirator and replacement filters and cartridges, with the exception of Type C which shall be provided by Contractor, and for having been previously and properly trained fit-tested, for the respirator used.

I. For use with air-purifying respirators, provide, at a minimum, HEPA type filters certified by NIOSH and MSHA for protection against asbestos fibers. In addition, a chemical cartridge may be added, if required for protection against chemicals used on this job.

J. For use with powered air purifying respirators, supply a sufficient quantity of HEPA filters approved for asbestos, so workers can change filters at any time that flow through the face piece decreases to the level at which the manufacturer recommends filter replacement.

K. For supplied-air respirator systems, provide equipment capable of producing air used for breathing in Type "C" supplied air respiratory systems that meets or exceeds standards set for C.G.A. Type 1, Gaseous Air, Grade D. (See 1.5.2.15) System must be certified by NIOSH/MSHA as an approved Type "C" respirator assembly operating in pressure demand mode with a positive pressure face-piece including as a minimum the following:

1. Auxiliary backup system
2. Escape air supply
3. Backup air supply
4. Warning Alarm Device
5. Compressor Shut Down
6. Compressor Motor (electric)
7. Compressor Location (outside building)
8. Air Intake
9. After-Cooler

3.5 AIR MONITORING; STOP ACTION AND CLEARANCE LEVELS

A. This section describes work being performed by the SI. The SI will not be performing air monitoring to meet Contractor's OSHA requirements for personal sampling or any other purpose.. The Contractor is to conduct air monitoring required by OSHA for Contractor personnel.

B. Analytical Methods: The following methods will be used by the SI in analyzing filters used to collect air samples. Minimum sample volumes will be 1200 liters for clearance samples.

1. Phase Contrast Microscopy (PCM) - will be performed using the OSHA Reference Method, Appendix A to 29 CFR 1926.1101, or NIOSH Method 7400.
2. Transmission Electron Microscopy (TEM) - will be performed using the analysis method set forth in the AHERA regulation 40 CFR Part 763 Appendix A, or NIOSH Method 7402, whichever is deemed more appropriate by SI in each case.

C. Before Start of Work: The SI will secure abatement work area air samples to establish a base line fiber level in each homogeneous abatement work area before start of work. All samples will be taken at the same time to ensure identical environmental conditions.

D. Daily: From start of abatement work through project decontamination, the SI may be taking samples on a daily basis inside and outside each abatement work area.

E. All Clearance Air Samples will be taken using aggressive sampling techniques.

F. Stop Action: If any air sample taken outside of the abatement work area exceeds 0.01 f/cc by PCM, or 70 structures per mm2 by TEM, depending on sampling method used, immediately and automatically stop all work except corrective action. PCM air samples will be re-analyzed by TEM to determine whether the high outside-of-work-area results were due to asbestos or non-asbestos fibers. The SI and the abatement contractor will determine the source of the high reading. The contractor will correct the condition, as appropriate.

G. Abatement Work Area Final Clearance Levels:

1. The SI standard for abatement work area final clearance in all occupied areas for removing the containment and re-occupancy is 70 structures per mm2 by TEM using the analysis method set forth in the AHERA regulation 40 CFR Part 763 Appendix A.
2. The SI standard for abatement work area final clearance in un-occupied areas, or at the case-by-case discretion of the SI, is less than 0.01 fibers per cubic centimeter of air using PCM methods specified in NIOSH 7400.
3. Final air clearance requirements of specific state and local regulations that exceed the requirements of 3.5.7.1 and 3.5.7.2 will be utilized (e.g., in the District of Columbia, at least two PCM samples per 2,500 square feet of floor are required).

3.6 INITIAL ISOLATION OF ABATEMENT WORK AREA

A. Contractor shall completely separate the abatement work area from other portions of the building, and the outside, by sealing all openings (windows, doorways, elevator openings, corridor entrances, drains, ducts, grill, diffusers, skylights, etc.) with barriers of 0.15 mm polyethylene sheeting and tape, or by sealing cracks leading out of the abatement work area. Contractor shall caulk the joints and seal holes in that portion of the walls, ceiling, and floor inside the abatement work area that could allow airborne asbestos fibers to be carried into adjoining spaces, or the exterior. Note in particular where pipes, conduit, and ductwork penetrate walls, ceilings and floor. Doorways and corridors which will not be used for passage during work must be sealed with 9.5 mm plywood, wood framing and plastic sheeting with tape.

B. All heating, ventilating, and air conditioning (HVAC) components that are in, supply or pass through the abatement work area shall be shut down. During asbestos removal and until job completion, elevators, exhaust fans, and HVAC vents and intakes will be key locked to not operate in the abatement work area. Coordinate with the COTR and Building Representative which areas are to be shut down and for what duration. Seal all intake and exhaust vents, and seams in system components, with a double layer of 0.15 mm polyethylene sheeting.

C. If it becomes necessary to shut down electric power to the enclosed abatement work area, then the contractor shall provide temporary power and lighting and ensure safe installation of temporary power sources and equipment in accordance with NFPA 70 electric code requirements.

D. Arrange for the abatement work area to be locked during non-work hours. Install temporary doors with entrance type locksets that are key lockable from the outside and always unlocked and operable from the inside. Remove deadbolts and padlocks. Provide one key (to be held by SI security office on site) to the COTR.

3.7 PREPARATION OF ABATEMENT WORK AREA AND TEMPORARY ENCLOSURES

A. No exhibit collection object shall be handled by the contractor without the approval of the COTR. Methods for surface decontamination and/or disposal of unsalvageable objects shall be determined with the input from the COTR, the object owner, the contractor and the SI IH.

B. Clean all contaminated furniture, equipment, and supplies with a HEPA-filtered vacuum cleaner or by wet wiping, as directed by the COTR, prior to being moved or covered.

C. Before removal, clean by HEPA-filtered cleaner and/or by wet wiping, all electrical and mechanical items, (such as lighting fixtures, clocks, diffusers, registers, etc.) and general construction items (such as cabinets casework, door and window trim, moldings, etc.) which cover the surface of the abatement work as required to prevent interference with the abatement work. Reinstall all such materials upon completion of the removal work with materials, finishes, and workmanship to match existing installations before start of work.

D. Remove all removable furniture, equipment, and supplies that have been deemed by the COTR to be uncontaminated, or completely cover with 2 layers of polyethylene sheeting, at least 0.15 mm in thickness, securely taped in place with duct tape. Such furniture, equipment, and supplies shall be considered outside the abatement work area unless covering plastic or seal is breached.

E. Clean all surfaces in abatement work area with a HEPA-filtered vacuum cleaner or by wet methods prior to installation of primary barrier.

F. All critical barriers, including ventilation openings (supply and exhaust), lighting fixtures, clocks, doorways, windows, speakers, and other openings into the abatement work area shall be individually sealed with 0.15 mm plastic sheeting and tape. Elevator doors, fire extinguisher cabinets and all other penetration in the floor, walls, or ceiling shall be sealed in the abatement work area. If a temporary polyethylene/stud wall must be erected, that wall shall be treated as a critical barrier. The double layer polyethylene containment enclosure shall then be erected on that wall. Critical barriers shall be sealed prior to installation of primary barriers

G. Take care in sealing of lighting fixtures and control boxes to avoid melting or burning of sheeting. The inside of unsealed lighting fixtures, control boxes, and buss lines are to be cleaned by asbestos workers specially certified to work on high voltage lines.

H. Cover floor of abatement work area with 2 layers of clear polyethylene, at least 0.15 mm in thickness, turned up at the walls at least 600 mm. Both spray-glue and duct tape all seams in floor covering. Size to minimize seams. Locate seams in top layer 2.0 meters from, or at right angles to, seams in bottom layer. Install sheeting so that top layer can be removed independently of bottom layer. Do not locate seams at wall/floor interface.

I. If carpeting is to remain, cover carpeting with three layers of polyethylene sheeting at least 0.15 mm in thickness. Place one layer of corrugated cardboard sheets between the top and middle layers of polyethylene.

J. Cover plastic sheeting in areas where scaffolding is to be used with a single layer of 12.7 mm fire retardant plywood. Wrap edges and corners of each sheet with duct tape.

K. Cover all walls in abatement work area including critical barrier sheet plastic with primary barrier of 2 layers of 0.15 mm polyethylene sheeting, mechanically supported and sealed with duct tape or spray-glue in the same manner as critical barrier sheet plastic. Size to minimize seams. Seams shall be staggered and separated by at least 600 mm. Wall sheeting shall overlap floor sheeting by at least 406 mm beyond wall/floor joint. Tape all joints including the joining with the floor covering with duct tape or as otherwise indicated by the COTR.

L. Cover interior surfaces of any existing elevator with 2 layers of 0.15 mm plastic sheeting. Arrange entry to abatement work area so that elevator door is in a positively pressurized space outside the clean room of the decon unit.

M. When installing the critical and primary barriers, automatic sprinkler heads and fire detectors shall not be covered or altered to prevent or delay operation. Smoke detectors should be protected (but not completely masked) to avoid nuisance alarms during paint or demolition operations. The covers on the smoke detectors shall be removed directly after such operations and at the end of the abatement workday.

N. A secondary barrier of plastic as a drop cloth shall be used to protect the primary layer from debris and shall be rolled and disposed as contaminated waste at the end of each workday.

O. Provide emergency exiting from the enclosure as required by NFPA 101, Life Safety Code. Arrange exit door(s) so that it is secure from outside the abatement work area but permits exiting from the abatement work area. Mark outline of door on barriers with luminescent paint at least 250 mm wide. Hang a razor knife on a string beside outline. Post a sign identifying "EMERGENCY EXIT", using letters at least 150 mm high, inside outline with luminescent paint. Arrows shall be taped on the polyethylene wall covering at eye level and at floor level to indicate location of exits. At entrance to decontamination chamber, post building floor plan and escape routes, plus locations of nearest exist and phone numbers of SI security. Emergency lighting shall be required, in accordance with the Life Safety Code.

P. A 4.5 kg ABC type portable fire extinguisher shall be located by each exit and clean room.

Q. Install inspection windows in the containment barrier enclosure system walls. Each window shall have a minimum 600 mm x 600 mm viewing area fabricated from 6.0 mm acrylic or polycarbonate sheeting. Install window with top at 2.0 m above floor height in a manner that provides unobstructed vision from outside to inside of the abatement work area. A sufficient number of windows are to be installed to provide observation of all portions of the abatement work area that can be made visible from adjacent areas. Provide also for viewing to be blocked from the inside with opaque plastic flap.

R. Where the abatement work area is immediately adjacent to or within view of occupied areas, provide a visual barrier of opaque polyethylene sheeting at least 0.15 mm in thickness so that the abatement work procedures are not visible to building occupants. Where this visual barrier would block natural light, substitute frosted or woven rip-stop sheet plastic in locations approved by the COTR.

S. Provide GFCI protection for all electrical equipment.

T. Provide temporary lighting inside the decontamination enclosure facility.

3.8 CONSTRUCTION OF WORKER/EQUIPMENT DECONTAMINATION AND WASTE LOAD-OUT ENCLOSURES

A. Worker/equipment decontamination enclosures shall be provided at each location where workers shall enter or exit the abatement work area.

B. The Contractor shall construct a worker/equipment decontamination enclosure consisting of at least a clean room, a shower room, and an equipment room, each separated by 900 mm air locks. Narrower air locks may be built if approved by the COTR.

1. All rooms shall be constructed of or fully lined with 0.15 mm thick polyethylene sheeting and suitable framing to make them as air-tight as possible. Where joining separate sheets of polyethylene is necessary, the two sheets of polyethylene shall be over-lapped at least 150 mm and adhered with an unbroken line of tape in such a manner to prohibit air movement. Stagger joints. Tape shall then be used to further seal the joint on the other side of the containment barrier so that both loose edges of the overlap are completely sealed.
2. Doorways will consist of three 3 sheets of 0.15 mm polyethylene from ceiling to floor. The width of these polyethylene sheets shall be sufficient to prevent air movement through the doorways when closed. These doorways shall be the only source of make-up air for the HEPA negative air filtration unit under normal circumstances, unless other sources are specifically approved by the COTR.
3. Provide GFCI protection for all electrical equipment.
4. Provide temporary lighting inside the decontamination enclosure facility.

C. The Clean Room shall have a curtained doorway leading to the outside of the abatement work area, and an airlock leading to the Shower Room. The clean room shall be of sufficient size to accommodate at least one worker, and a supply of clean disposable coveralls and storage facilities for street clothing, and uncontaminated equipment.

D. The Shower Room shall have two airlocks, one adjacent to the clean room and one adjacent to the equipment room. The Shower room shall provide hot and cold running water and soap and towels. It should have adequate space for a shower stall. Waste water from the shower shall be discharged through a water filtration unit efficient to 5 microns, then to a sanitary sewer. Shower room shall have opaque walls.

1. Shower Stall: Provide leak tight shower enclosure unit with integrated drain pan fabricated from fiberglass or other durable waterproof material. Equip with hose bibs for hot and cold water. Arrange water shut off and drain pump operation controls so that a single individual can shower without assistance from either inside or outside of the abatement work area. Provide splash proof entrances. Provide back flow prevention device and vacuum breaker, where required. Connect drain to a reservoir, pump water from reservoir through filters to a drain. Mount filters inside shower stall in manner that allows for access for filters to be changed from inside the shower. Change filters daily or more often if necessary. Locate filters inside shower unit so that water lost during filter changes is caught by shower pan. Provide temporary extensions of existing (if available and authorized for Contractor use by COTR) hot and cold water and drainage, as necessary for a complete and operable shower.

2. Filtered Waste Water Drainage: Provide cascaded disposable HEPA filter units on drain lines from showers or any other fluid source carrying ACM. Connect so that discharged water passes primary filter and output of primary (particles 20 microns and smaller) filter passes through secondary (particles 5 microns and smaller) filter.
3. Sump Pump: Provide totally submersible waterproof sump pump with integral float switch. Provide unit sized to pump 2 times the flow capacity of all showers or hoses supplying water to the sump, through the filters specified herein when they are loaded to the extent that replacement is required. Provide unit capable of pumping debris, sand, plaster or other materials washed off during decontamination procedures without damage to mechanism of pump. Adjust float switch so that a minimum of 75 mm remains between top of liquid and top of sump pan.

E. The Equipment Room shall have two airlocks, one adjacent to the abatement work area and one adjacent to the shower room. The room shall be of sufficient size so as to accommodate at least one worker to change clothes, and temporarily house any equipment which the contractor wishes to store when not in use. The area shall have facilities for decontaminating material and equipment, and a container lined with 0.15 mm polyethylene bag for collection of disposable coveralls and foot coverings.

F. Waste Load-Out Enclosure: Asbestos-contaminated waste that has been containerized shall be transported out of the abatement work area either through the personnel/equipment decontamination enclosure or through a separate waste load-out enclosure. If a separate enclosure is used, it shall be built with two airlocks, with curtained doorways: one to the abatement work area and one to an uncontaminated area outside the abatement work area.

3.9 AIR CIRCULATION INSIDE CONTAINMENT BARRIER

A. Formula for Quantity of Air-Filtration Units: The number of air filtration units needed to achieve the required air circulation rate shall be determined by the following formula:

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CALCULATE	Volume of abatement work area (CF)
MULTIPLY BY	Number of air changes per hour, four to ten.
MULTIPLY BY	1/60 (hr/minutes)
DIVIDE BY	Capacity of air filtration unit fully loaded with all filters (pressure differential activates warning light for loaded filters)
DIVIDE BY	80% expected efficiency
ADD	one additional unit as backup for machine failure or shutdown
EQUALS	minimum number of units required

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B. Supplemental Makeup Air Inlets: As necessary to achieve air flow throughout the abatement work area, locate auxiliary makeup air inlets as far away as possible from the air filtration units, preferably near the ceiling and away from barriers that separate the containment barriers and enclosures from surrounding areas. Cover inlet with plastic sheeting flaps to reseal automatically if the pressure differential system should shut down for any reason. Provide rigid framing around the opening. Spray the flap and around opening with spray adhesive so that if flap closes, the meeting surfaces are both covered with adhesive. Use adhesive that forms contact bond when dry. If used during clearance monitoring, tape or seal HEPA filters over inlets.

C. Penetrations through masonry and/or fire walls, required for improving air circulation, shall be protected with a fire damper.

D. Accomplish the pressure differential by exhausting a sufficient volume of HEPA filtered air from the abatement work area. Efforts to achieve pressure isolation shall first address:

1. Establishing required air circulation
2. Verifying seals are complete as practical
3. Establishing increased pressure in adjacent areas, if available
4. Exhausting sufficient volume of HEPA filtered air with additional air filtration units.
5. Decreasing the size of abatement work area to affect a smaller volume required for filtration

3.10 PLACEMENT OF AIR FILTRATION SYSTEM UNITS

A. Equipment shall be located so as to optimize air movement throughout the abatement work area by positioning air filtration units as far away as practical from the access opening or other supplemental make-up air inlets.

B. The auxiliary air-filtration unit shall be located on site and available and ready to run at any time.

C. Air movement shall be established in such a way that air borne fibers will be carried away from workers' breathing zones.

D. Dead air pockets shall be minimized by proper ducting of make-up air if necessary, and by optimum location of the negative air filtration units.

E. The Contractor shall use smoke tubes to determine if dead air spots are present and shall take corrective action as outlined above when they are found. Report such actions to the COTR immediately.

F. The air filtration units shall be placed so that access for changing the filters is inside the containment barrier. The unit is to run continuously during filter changing. A supply of filters shall be kept on site outside of containment area. If a unit must be turned off for servicing, an auxiliary unit must be in place and turned on.

G. Vent to the outside of the building, whenever practical, as determined by the COTR. Units may be vented inside the building only if outside venting is impractical. Units venting inside a building must be vented through an expansion chamber or diffuser system (self-contained water baffle) to reduce exhaust air velocity. A secondary HEPA unit may also be used after the expansion chamber/diffuser. Terminal exhaust ductwork must be placed as far away as possible from occupied areas. Special provisions for air monitoring shall be implemented by the SI air monitoring firm.

H. Mount units to exhaust directly or through disposable ductwork. Use ductwork and fittings of same diameter or larger than discharge connection on fan unit. Use spiral wire-reinforced flex duct in lengths not greater than 15 meters. If direction of discharge from fan unit is not aligned with duct use sheet metal elbow to change direction. Use six feet of spiral wire reinforced flex duct after direction change.

I. All HEPA units shall be tested in-place before removal begins. Test will be the responsibility of the contractor.

3.11 PRESSURE DIFFERENTIAL ISOLATION

A. The abatement work area and the decontamination enclosure system shall be maintained at a negative pressure relative to adjacent areas. The relative pressure differential when measured across any physical or critical barrier must continuously equal or exceed a static pressure of 0.5 mm of water. Measurement shall be by manometer or magnahelic gage.

B. Minimum 4 air changes per hour. Continuous HEPA filtered exhaust unit is to be in operation until job is completed.

C. Make-up air shall be obtained only through the decontamination enclosure facilities, or as provided in Section 3.9.2 of these specifications.

D. Where asbestos-containing material covers an opening or joint, provide negative air pressure sufficient to draw air from the adjoining space into the containment barrier when the opening or

joint is exposed after asbestos removal. Seal newly exposed openings and joints immediately to prevent contamination of adjoining spaces.

E. Supply sufficient pre-filters to allow frequent changes.

F. During and after the pre-abatement test, run the air filtration units continuously to maintain a constant pressure differential and air circulation until decontamination, cleaning, and encapsulation of the abatement work area is complete.

G. The HEPA-filtered units shall be left on continuously until after final clearance air measurement of 0.01 f/cc or the pre-removal background level, whichever is lower is achieved, and the COTR authorizes the shut-down of the units. Where feasible, the units shall be left on until the enclosure is completely removed.

H. HEPA units must be set up to cause an alarm-bell or buzzer to sound should the HEPA filter become clogged or the exhaust unit fails in operation after working hours. The alarm must be loud enough to alert a SI Security Officer of the equipment failure. The guard will phone a previously designated contractor employee whose 24-hour number shall have been recorded at the beginning of the project. The notified contractor will immediately dispatch a repair crew to the job site. A spare HEPA unit shall always be available to immediately restore negative air pressure.

I. If the pressure differential between inside and outside the containment barrier drops to 0.4 mm of water, the Contractor will immediately inspect the containment for sources of pressure leaks and report actions taken to the SI IH and COTR. The system warning alarm shall sound if pressure drops below 0.03 mm of water, and work shall stop.

3.12 PRE-ABATEMENT INSPECTION, TESTING, AND APPROVAL

A. Pre-Abatement Testing Requirements: Contractor must demonstrate with continuous data log that abatement work area can hold negative pressure of 0.5 mm of water for a minimum of 2 hours, prior to commencement of actual asbestos removal, unless the system is exhausted through an isolated ventilation system. In this case, the test period shall be long enough to ensure that the lock-out ventilation controls are not over ridden and the HVAC system does not reactivate. As a minimum, the Contractor shall make all arrangements and demonstrate satisfactory equipment operation and set-up for compliance with these specifications.

1. Show proper condition of equipment seals including results of in-place HEPA-filter testing.
2. Show proper operation of safety and warning devices.
3. Show proper operation and calibration of instrumentation.
4. Show identification of equipment unit and fan capacity.

5. Use smoke tubes to demonstrate adequate air circulation, elimination of dead air pockets, and positive air motion through the decontamination enclosure system into the abatement work area.
6. Show the installation method for pre-filters and the HEPA primary filter in the air filtration unit. Show supply of filters available on site.
7. Demonstrate and record that a minimum 0.50 mm of water pressure differential has been achieved and can be maintained.
8. Demonstrate procedures for how workers will enter and exit the decontamination enclosure system.
9. Demonstrate procedures for handling emergencies and for the prevention of contamination of surrounding areas.
10. With COTR and Building Representative, identify disabled building ventilation systems and the positive means that will prevents accidental or premature restarting. Confirms means to have unit restarted at the conclusion of the abatement work. With COTR and Building Representative, verify that all equipment affected is secured at the main breaker.
11. Demonstrate how contaminated shower water is filtered and drained.
12. Use a pressure differential meter or manometer to demonstrate the required pressure differential at every barrier separating the abatement work area from the balance of the building, equipment, ductwork or outside.
13. Demonstrate that each air filtration unit is serviced by a dedicated minimum 115V-20A circuit with GFCI protection.
14. Demonstrate how asbestos will be removed and bagged for transport. Identify procedures for hauling through the building to the loading dock.

3.13 MAINTENANCE OF CONTAINMENT BARRIER AND ENCLOSURES

A. Ensure that the containment barrier, decontamination enclosure rooms, and other sealed doors, vents, etc., and plastic linings are effectively sealed and taped for the duration of the abatement work.

B. Repair damaged barriers and remedy defects immediately upon discovery. Visually inspect enclosure at the beginning of each work period.

C. Damaged or deteriorating materials shall not be used and shall be removed from the premises. Material that becomes exposed to and contaminated with asbestos shall be decontaminated or disposed of in accordance with the applicable regulations and special requirements.

D. Clean debris and residue from inside of the decontamination enclosure system on a daily basis. Damp wipe or hose down all surfaces after each shift change. Clean debris from shower pans on a daily basis.

E. Maintain floors in the clean room and airlocks as dry as possible to minimize slips and trips. Damp wipe all surfaces twice after each shift change with a disinfectant solution.

3.14 REMOVAL OF ASBESTOS-CONTAINING MATERIALS (ACM) - GENERAL

A. Prohibited Work Practices. The following methods shall not be used for work related to or disturbing asbestos, regardless of exposure level:

1. High-speed abrasive disc saws that are not equipped with point of cut ventilation or enclosures with HEPA-filtered exhaust air.
2. Compressed air used to remove asbestos, or materials containing asbestos, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.
3. Dry sweeping, shoveling or other dry cleanup of dust and debris containing ACM and PACM.
4. Employee rotation as a means of reducing employee exposure to asbestos.

B. Methods of Compliance. The following engineering controls and work practices shall be used, at a minimum, for all asbestos tasks:

1. HEPA-filtered vacuum cleaners.
2. Wet methods.
3. Prompt cleanup and disposal.

C. The following work shall be done only after the decontamination facilities have been constructed, the area has been isolated and can be maintained under negative air pressure as specified in the previous section, pre-abatement background sampling has been conducted, and arrangements have been made for disposing waste at an acceptable site.

D. Start abatement work at a location farthest from the fan units and proceed toward them. If an electric power failure occurs, immediately stop all abatement work and do not resume until power is restored and negative air filtration units are operating again. Immediately notify COTR of occurrence. Any torn or unsealed plastic sheeting shall be immediately repaired. Floor sheeting shall be replaced if damaged.

E. Wet Removal: Prior to stripping and/or tooling, the asbestos material shall be sprayed using an airless pump and wetting agents (amended water or removal encapsulant) to enhance penetration and reduce fiber dispersal into the air.

1. A fine spray of amended water shall be applied to reduce fiber release preceding the removal of the asbestos material. The material shall be sufficiently saturated to prevent emission of excessive airborne fibers.
2. Spray material repeatedly during the abatement work process to maintain a continuously wet condition. If a removal encapsulant is used, apply in strict accordance with manufacturer's instructions. Perforate outer covering of any insulation which has been painted and/or jacketed in order to allow penetration of water, amended water or removal encapsulant. Where necessary, carefully strip away while simultaneously wetting the insulation to minimize dispersal of asbestos fibers into the air.
3. Remove materials in manageable quantities and control the descent to the staging or floor below. If over 6 meters, use drop chutes to contain material during descent.

F. Gross removal of dust and debris from contaminated material, material containers, and equipment shall be accomplished in the containment barrier before removal to the equipment decontamination room for wet sponging before leaving the abatement work site.

3.15 REQUIREMENTS FOR SPECIFIC ACM AND METHODS – FIREPROOFING / SOUNDPROOFING ON SCRATCH COAT OR WIRE LATH

A. Spray asbestos-containing fireproofing or architectural acoustic finish with a fine mist of amended water. Allow time for amended water to saturate materials to substrate.

B. Spray the asbestos-containing material repeatedly during the abatement work to maintain wet condition but do not use excessive amounts of water that results in ponding or entry into other areas of the building.

C. Do not over-saturate to cause excess dripping. Scrape materials from substrate. Remove residue remaining on scratch coat after scraping using stiff nylon bristled hand brush. Use high pressure washer only with written authorization from the COTR.

D. Remove the saturated asbestos-containing material in small sections. Do not allow material to dry out. As it is removed, place the material in sealable plastic bags of 0.15 mm minimum thickness.

E. Carefully lower removed and bagged asbestos-containing material to the floor without dropping or throwing, or transport to the floor via dust-tight chutes or containers, in accordance with the procedures set forth in 40 CFR 61.147.

F. Cut wire lath into 50 mm x 150 mm sections and cut hanger wires. Roll or fold up complete with asbestos-containing material and hand place in container. Do not drop on floor. After removal of lath and asbestos-containing material remove any overspray on decking and structure above using stiff nylon bristled brush. Use one of the following methods for containing waste.

1. Wrap material in felt and place in fiberboard drum lined with two disposal bags. Use caution to ensure that all edges of wire lath that could cut plastic are covered with felt.
2. Place material directly in a steel drum. Use waste containers which are impervious to puncture, leakage, tearing, or ripping from wire lathe.

3.16 REQUIREMENTS FOR SPECIFIC ACM AND METHODS - VINYL ASBESTOS TILE (VAT) AND MASTIC

A. Full containment barriers, with pressure differential ventilation units, shall be used. Dispose as ACM.

B. Removal of asbestos-containing floor tile and mastic, baseboard and mastic shall be performed in accordance with the procedure outlined below.

1. All critical barriers, including ventilation openings (supply and exhaust), lighting fixtures, clocks, doorways, windows, speakers, and other openings into the work area shall be individually sealed with 0.15 mm plastic sheeting and tape. Elevator doors, fire extinguisher cabinets and all other penetration in the floor, walls, or ceiling shall be sealed in the abatement work area.
2. Prepare a worker and/or equipment decontamination and waste load-out enclosure as previously specified.
3. Cover all walls in the abatement work area with two layers of 0.15 mm polyethylene sheeting and seal with duct tape or spray-glue. The sheeting shall be applied to a height of 1.5 m above the floor. The seams shall be staggered and separated by at least 150 mm.
4. Wet asbestos-containing materials with amended water to minimize fiber release during removal. Use amended water sparingly to eliminate standing water and to prevent water from traveling on the floor.
5. Remove tiles individually and minimize breakage. Heat guns may be used to heat tile and soften the adhesive. Immediately place tiles in disposal bags.
6. Non-toxic organic solvents may be used to remove mastic.
7. Wet clean all surfaces to remove residual material. Continue cleaning until abatement work area is free of visible material.
8. Proceed to clearance testing following approval from COTR that abatement work area is visually free of asbestos-containing materials.

3.17 REQUIREMENTS FOR SPECIFIC ACM AND METHODS - ROOFING

A. Use the wet removal method for ACM to eliminate visible emissions in accordance with NESHAP regulations. Controls shall be used to prevent re-entrainment into building HVAC system. Dispose as ACM.

1. Spray large areas of asbestos-containing roofing material thoroughly with amended water using spray equipment recommended by surfactant manufacturer capable of providing a "mist" application to reduce the release of fibers. Spray the asbestos material repeatedly during the abatement work process to maintain wet conditions, but do not use excessive amounts of water that result in ponding or entry into building.
2. Remove the asbestos-containing material in small sections. Do not allow material to dry out. As it is removed, place the material in sealable plastic bags of 0.15 mm minimum thickness. Place sealed asbestos debris in second 0.15 mm plastic bag, appropriately labeled, and remove from abatement work area.
3. Carefully lower removed and bagged asbestos-containing material to the ground without dropping or throwing, or transport to the ground via dust-tight chutes or containers, in accordance with the procedures set forth in EPA 40 CFR 61.147 Code of Federal Regulations.
4. Clean area of all debris and notify COTR for visual inspection.

3.18 REQUIREMENTS FOR SPECIFIC ACM AND METHODS – EXTERIOR AND INTERIOR WINDOW CAULK

A. Exterior: Work will be done from the exterior of the building. If lifts are needed, lift platforms should be covered with canvass drop cloths.

B. Interior: If lifts are needed, lift platforms should be covered with canvass drop cloths.

C. Cover the ground or floor area below the abatement work area with 2 layers of 0.15 mm polyethylene sheeting.

D. Wet the asbestos-containing materials with amended water to minimize fiber and dust release during removal. Use amended water sparingly to eliminate standing water and to prevent water from traveling on the ground sheeting.

E. Remove the window caulk in small sections using manual methods, not power tools. Keep the material wet with amended water and do not allow the material to dry out. As it is removed, place the material in sealable plastic bags of 0.15 mm minimum thickness, and completely seal the bag. Place sealed debris bag into a second 0.15 mm plastic bag, and completely seal the bag.

F. Carefully lower the sealed material debris bag to the polyethylene sheeting on the ground without dropping or throwing.

G. After removal of the sealed material debris bags from the work area, HEPA vacuum and wet-clean all surfaces and equipment in the abatement work area to remove residual accumulated material. Continue cleaning until the surfaces are visibly free of material.

H. Place dropcloths and other abatement related disposable materials into sealable plastic bags of 0.15 mm minimum thickness, and completely seal the bag. Place sealed debris bag into a second 0.15 mm plastic bag, and completely seal the bag. Remove from the work site and dispose as asbestos waste per these specifications.

I. Notify COTR for visual inspection.

3.19 REQUIREMENTS FOR SPECIFIC ACM AND METHODS - GYPSUM WALLBOARD JOINT COMPOUND

A. All critical barriers, including ventilation openings supply and exhaust), lighting fixtures, clocks, doorways, windows, speaker, and other openings into the abatement work area shall be individually sealed with 0.15 mm plastic sheeting and tape. Elevator doors, fire extinguisher

cabinets and all other penetrations in the floor wall, or ceiling shall be sealed in the abatement work area.

B. Prepare worker/equipment decontamination and waste load-out enclosure as previously specified.

C. Isolate the abatement work area by constructing a temporary double layered 0.15 mm polyethylene/stud wall.

D. Cover the floor of the abatement work area with 2 layers of 0.15 mm polyethylene sheeting turned up at walls at least 600 mm.

E. Wet the asbestos-containing materials with amended water to minimize fiber and dust release during removal. Use amended water sparingly to eliminate standing water and to prevent water from traveling on the floor.

F. Remove the gypsum wallboard and joint compound in small sections. Do not allow the material to dry out. As it is removed, place the material in sealable plastic bags of 0.15 mm minimum thickness. Place sealed debris in a second 0.15 mm plastic bag and remove from the work area.

G. Carefully lower the material to the floor without dropping or throwing.

H. After removal of the material, HEPA vacuum and wet-clean all surfaces in the abatement work area to remove residual accumulated material. Continue cleaning until the surfaces are visibly free of material.

3.20 REQUIREMENTS FOR SPECIFIC ACM AND METHODS - DUCT INSULATION MASTIC

A. All critical barriers, including ventilation openings (supply and exhaust), lighting fixtures, clocks, doorways, windows, speaker, and other openings into the abatement work area shall be individually sealed with 0.15 mm plastic sheeting and tape. Elevator doors, fire extinguisher cabinets and all other penetrations in the floor wall, or ceiling shall be sealed in the abatement work area.

B. Prepare worker/equipment decontamination and waste load-out enclosure as previously specified.

C. Isolate the abatement work area by constructing a temporary double layered 0.15 mm polyethylene/stud wall.

D. Cover the floor of the abatement work area with 2 layers of 0.15 mm polyethylene sheeting turned up at walls at least 600 mm.

E. Wet the asbestos-containing materials with amended water to minimize fiber and dust release during removal. Use amended water sparingly to eliminate standing water and to prevent water from traveling on the floor.

F. Removed the duct wrap and insulation and the duct mastic in small sections. Do not allow the material to dry out. As it is removed, place the material in sealable plastic bags of 0.15 mm minimum thickness. Place sealed debris in a second 0.15 mm plastic bag and remove from the work area.

G. Carefully lower the material to the floor without dropping or throwing.

H. After removal of the material, HEPA vacuum and wet-clean all surfaces in the abatement work area to remove residual accumulated material. Continue cleaning until the surfaces are visibly free of material.

3.21 REQUIREMENTS FOR SPECIFIC ACM AND METHODS - CONTAMINATED SOILS

A. Saturate dry soil with amended water or a removal encapsulant for a depth of 75 mm. Remove the top 25mm of soil. Start removal at the point of work farthest from the entrance to the soil floor area and proceed toward the entrance. Do not permit traffic into the fresh soil surface. After the entire first layer of soil is removed, completely change coveralls and at the entrance to the soil removal area don clean boot covers. Use amended water to keep the surface of the soil continuously wet throughout removal and decontamination. Remove the second 25 mm of soil in the same manner as the first. Remove the third 25 mm of soil in the same manner as the previous 50 mm.

3.22 REQUIREMENTS FOR SPECIFIC ACM AND METHODS - CONTAMINATED CARPETING

A. Deface carpeting with a light coat of contrasting spray paint before the abatement work. Coat lightly enough that wetting will not be retarded. Prior to cutting, thoroughly wet the asbestos-contaminated carpeting to be removed to reduce fiber dispersal into the air. Accomplish the wetting by using a fine spray (mist) of amended water or encapsulant. Saturate material completely without causing excess dripping. Allow time for water or encapsulant to penetrate material thoroughly. Roll up carpeting and dispose of as ACM.

3.23 REQUIREMENTS FOR SPECIFIC ACM AND METHODS -REMOVAL OF ASBESTOS-CONTAINING TRANSITE PANELS.

A. Develop a daily removal plan indicating the square footage of panel material that will be removed during the abatement working day.

B. Establish a regulated area by posting necessary barricades and warning signs to isolate the abatement work area.

C. Prior to commencing work, establish a regulated area by covering the surface with plastic sheeting a minimum of 4.5 m from the panels being removed.

D. At all times, keep the panels misted with water.

E. Remove the panels individually and minimize breakage.

F. Gently place the panels in bags or wrap the panels in two layers of 0.15 mm plastic sheeting.

G. Collect and dispose of any debris that falls on the plastic sheeting as asbestos-containing material.

H. Wet-clean all surfaces of the structure which secured the panels to remove residual ACM.

I. Encapsulate the structure surfaces wet-cleaned in (h) above.

J. Wet wipe the plastic sheeting prior to disestablishing the regulated area and dispose of the sheeting as contaminated waste.

3.24 REQUIREMENTS FOR SPECIFIC ACM AND METHODS - GLOVE-BAG REMOVAL METHOD

A. Preparation: Before any work commences, a layer of polyethylene sheeting shall be placed on the floor, as a drop cloth, beneath the glove bag abatement work area. A temporary enclosure shall be constructed around the general removal area to separate it from occupied areas of the building and to serve as a physical barrier should accidental fiber release occur. Appropriate warning signs shall be posted outside this barrier in areas of high visibility. A HEPA filtered air filtration unit shall be on-site to be used to contain an emergency fiber release.

B. Remove asbestos-containing material inside a glove bag according to manufacturer's guidelines. Thoroughly wet material to be removed with amended water or removal encapsulant and allow to soak through to substrate.

C. Each glovebag shall be installed so that it completely covers the circumference of pipe or other structure where the work is to be done.

D. Glovebags shall be smoke-tested for leaks and any leaks sealed prior to use.

E. Glovebags may be used only once and may not be moved.

F. Glovebags shall not be used on surfaces whose temperature exceeds 65o C.

G. Before beginning the operation, loose and friable material adjacent to the glovebag/box operation shall be wrapped and sealed in two layers of 0.15 mm plastic sheeting or otherwise rendered intact.

H. Use two people for glove-bag operation. One shall remove insulation, the other shall operate water sprayer and repair any leaks in bag.

I. Using a small HEPA vacuum, create a negative pressure inside the glove-bag before starting any asbestos removal and maintain throughout the use of the bag.

J. Gently remove insulation from pipe and place it in bottom of bag.

K. After removal of insulation, brush and wet-clean pipe to remove residual material. Continue wet cleaning until surfaces are free of visible material. Clean area of all debris and notify COTR for visual inspection.

L. Spray all tools with water inside bag and place back in pouch.

M. Where system uses attached waste bag, such bag shall be connected to collection bag using hose or other material which shall withstand pressure of ACM waste and water without losing its integrity.

N. Sliding valve or other device shall separate waste bag from hose to ensure no exposure when waste bag is disconnected.

O. Wet and seal visible ends of remaining pipe insulation.

P. Spray the inside of the bag with amended water and remove the watering wand, taping the water sleeve closed.

Q. Tape the make-up air opening closed.

R. Using the HEPA-vacuum, collapse bag and seal off lower portion containing asbestos-containing material and gloves of the bag.

S. Remove bag from pipe and tools from pouch.

T. Glove-bag shall be considered the first container for material. Dispose of properly.

U. Encapsulate abated section of pipe and any adjacent pipe as required.

V. Accidental Fiber Release During Glove Bag Removal: If the glove bag is accidentally cut open, duct tape from inside the bag shall be used to seal the opening. If the glove bag should rupture during abatement, the drop cloth sheeting beneath the bag shall be used to contain the bag by bringing the edges together, twisting, taping and folding over in gooseneck fashion and taping again. The area around and under this cloth shall be cleaned with a HEPA vacuum.

3.25 REQUIREMENTS FOR SPECIFIC ACM METHODS: NEGATIVE PRESSURE GLOVE BOX SYSTEMS

A. Negative pressure glove box systems shall be used to remove ACM or PACM from pipe runs with the following specifications and work practices:

1. Specifications:
    a. Glove boxes shall be constructed with rigid sides and made from metal or other material which can withstand the weight of the ACM and PACM and water used during removal.
    b. A negative pressure generator shall be used to create negative pressure in system.
    c. An air filtration unit shall be attached to the box.
    d. The box shall be fitted with gloved apertures.
    e. An aperture at the base of the box shall serve as a bagging outlet for waste ACM and water.
    f. A back-up generator shall be present on site.
    g. Waste bags shall consist of 0.15 mm thick plastic, double-bagged before they are filled, or plastic thicker than 0.15.mm.
2. Work Practices:
    a. At least two persons shall perform the removal.
    b. The box shall be smoke tested prior to each use.
    c. Loose or damaged ACM adjacent to the box shall be wrapped and sealed in two layers of 0.15 mm plastic prior to the job, or otherwise made intact prior to the job.

d. A HEPA filtration system shall be used to maintain pressure barrier in box.

3.26 REQUIREMENT FOR SPECIFIC ACM METHODS: WATER SPRAY PROCESS SYSTEM

A. A water spray process system may be used for removal of ACM and PACM from cold line piping if, employees carrying out such process have completed a 40-hour separate training course in its use, in addition to training required for employees performing Class I work. The system shall meet the following specifications and shall be performed by employees using the following work practices.

1. Specifications:
   a. Piping shall be surrounded on three sides by rigid framing.
   b. A 360 degree water spray, delivered through nozzles supplied by a high pressure separate waterline, shall be formed around the piping.
   c. The spray shall collide to form a fine aerosol which provides a liquid barrier between workers and the ACM and PACM.
2. Work Practices:
   a. The system shall be run for at least ten minutes before removal begins.
   b. All removal shall take place within the water barrier.
   c. The system shall be operated by at least three persons, one of whom shall not perform removal, but shall check equipment, and ensure proper operation of the system.
   d. After removal, the ACM and PACM shall be bagged while still inside the water barrier.

3.27 REQUIREMENT FOR SPECIFIC ACM METHODS: MINI ENCLOSURE

A. A small walk-in enclosure which accommodates no more than two persons may be used if the disturbance or removal can be completely contained by the enclosure with the following specification and work practices.

1. Specifications:
   a. The fabricated or job-made enclosure shall be constructed of 0.15 mm plastic or equivalent.
   b. The enclosure shall be placed under negative pressure by means of a HEPA filtered vacuum or similar ventilation unit.
2. Work Practices:
   a. Before use, the mini-enclosure shall be inspected for leaks and smoke tested to detect breaches, and breaches sealed.
   b. Before reuse, the interior shall be completely washed with amended water and HEPA-vacuumed.
   c. During use air movement shall be directed away from the employee’s breathing zone within the mini-enclosure.

3.28 REQUIREMENTS FOR SPECIFIC ACM AND METHODS - DRY-REMOVAL OF ELECTRICAL EQUIPMENT

A. Do not begin dry removal work until authorized in writing by the EPA NESHAP coordinator and the COTR. A State regulatory authority waiver may be required and if so shall be obtained by the contractor. Use where wetting may create a hazard for workers or damage equipment or finishes, such as electrical closets, transformer vaults, high pressure steam lines, etc. Work on active electrical equipment is to be performed by qualified trades person with prior experience in the installation or repair of the involved equipment. Restrict access to electrical equipment.

3.29 POST REMOVAL: CLEANING AND CLEARANCE

A. Provide general clean-up of abatement work area concurrent with the removal of all asbestos-containing materials. Do not permit accumulation of debris on workspace floor.

B. Do not perform dry dusting or dry sweeping.

C. Maintain the minimum required pressure differential of 0.50 mm of water inside the abatement work area enclosure at all times, and until the COTR authorizes the Contractor to remove the enclosure.

D. During decontamination of automatic sprinkler and smoke detectors, the Smithsonian security office must be contacted for possible nuisance alarms. Care must be taken in the wiping down of the sprinkler heads and smoke detectors so as not to damage them. Smoke detectors must be vacuumed clean as directed by the Fire Alarm Shop, Office of Physical Plant.

E. Initial Phase Cleanup Sequence

1. Remove all visible accumulations of asbestos-containing material and debris.
2. Wet clean and HEPA-vacuum all surfaces in the abatement work area.
3. Clean all equipment (excluding that which will be needed for further cleaning phases) used in the abatement work area and remove from abatement work area via the Equipment Decontamination Enclosure.
4. Remove the top layer (secondary barrier) of plastic sheeting, change all air filtration system pre-filters, and proceed with the second cleaning.
5. Replace all HEPA-filters and pre-filters in air filtration air machines with clean filters. Clean all air filtration machines.
6. Notify SI IH for observation of cleaning to determine completeness. Plastic sheeting surfaces will be considered clean when free from dust, dirt, residue, film, or discoloration resultant from abatement operations or other activities subordinate to these operations.
7. Perform no activity in abatement work area for at least 12 hours in order to allow settlement of airborne fibers. No reduction in this settling period will be allowed.

F. Secondary Phase Cleanup Sequence

1. Wet clean and HEPA-vacuum all surfaces in abatement work area at least one more time.
2. Notify SI IH for observation to determine completeness of cleaning.
3. SI IH will perform a visual observation of the abatement work area in general accordance with ASTM 1368, Standard Practice for Visual Inspection of Asbestos Abatement Projects.
4. If visual clearance is not attained, then subsequent re-cleaning will be required. This sequence will continue until visual clearance is attained.
5. When visual clearance has been obtained, the plastic barriers down to the critical barriers may be removed.

G. Final Air Clearance Testing.

1. SI IH will test for the final air clearance levels, in accordance with 3.5.7 of this specification, when areas have passed the visual clearance phase. Final air testing shall be performed using aggressive air sampling techniques.
2. Re-clean and continue to clean at Contractor's expense, areas which do not comply with the specified final clearance level.

H. Consider abatement work areas and all other decontaminated and cleaned areas clean when:

1. All phases of clean up have been completed and level of cleanliness is approved by COTR.
2. All asbestos final clearance testing results will be as specified in 3.5.7 of this specification.

I. After area passes final air clearance dismantle Decontamination Enclosure Systems and thoroughly HEPA-vacuum and wet clean immediate areas.

J. Dispose of debris from removal operation, used cleaning materials, unsalvageable materials used for sturdy barriers, and any other remaining materials. Consider the materials to be contaminated and dispose of accordingly.

K. The "COTR's Certification of Visual Inspection and Final Air Sampling for Asbestos Abatement" form (see page 45) or equivalent shall be completed, signed by the Contractor, SI IH, COTR and included with the COTR project records. The COTR shall provide written results of all visual inspections and final clearance testing to the facility safety coordinator.

3.30 POST CLEARANCE: APPLICATION OF LOCKDOWN ENCAPSULANT TO BASE MATERIAL

A. Pre-Lockdown Encapsulant Mock-up Test: Prior to beginning lockdown encapsulant work, provide a sample area for approval by the COTR. Notify the COTR a minimum of 72 hours in advance to schedule the test. Lockdown encapsulant shall be applied using methods set forth in ASTM Proposed Specification P-189 "Specification for Encapsulants for Friable Asbestos Containing Building Materials". The test must be witnessed by the COTR or as otherwise designated by the COTR. The approved procedures and materials shall serve as a standard for the balance of the lockdown encapsulant work.

B. Apply encapsulant only when environmental conditions in the abatement work area are as required by the manufacturer's instructions and the COTR. Prior to applying any encapsulant, ensure that its application will not cause the base material to fail and allow the encapsulated material to fall of its own weight or separate from the substrate.

C. Apply encapsulant with an airless spray gun with air pressure and nozzle orifice or as otherwise recommended by the encapsulant manufacturer.

D. Encapsulant Application to Plaster Scratch Coat: Apply two coats of encapsulant to the scratch coat plaster after all ACM has been removed. Apply in strict accordance with the manufacturer's printed instructions. Any deviations from such printed instructions must be approved by the COTR in writing prior to commencing work.

1. Apply the first coat of encapsulant while the plaster scratch coat is still damp from the asbestos removal procedures. If the surface has been permitted to dry, vacuum surface with a HEPA vacuum prior to applying the encapsulant.
2. Apply second coat over first coat in strict conformance with manufacturer's instructions.
3. Color the encapsulant with contrasting colors in alternate coats so that visual confirmation of complete and uniform coverage of each coat is possible. Adhere to manufacturer's instructions for coloring. At the completion of work, the encapsulated surface must be a uniform third color produced by the mixture.
4. Sealing Exposed ACM edges: Prior to encapsulation, permit the exposed edges to dry completely to permit penetration of the encapsulant. Seal edges of ACM with two coats of encapsulant. Label the joint for the portions which are asbestos and non-asbestos.

3.31 CONTAINMENT BARRIER REMOVAL

A. Following area final clearance and lockdown encapsulation, leave pressure differential units running as long as feasible during containment barrier removal.

B. Equipment, machinery, scaffolding, tools, etc., within the abatement work area shall not be removed without first being thoroughly cleaned with amended water or in the case of delicate items susceptible to rust, an acceptable substitute.

C. After the abatement work area is found to be in compliance, the remaining sealed areas and exits are unsealed and the plastic sheeting, tape, and any other trash and debris are disposed of in sealable plastic bags and treated as asbestos waste. The SI IH will conduct a final walkthrough and document results for the COTR.

D. Before removal from the abatement work area, remove and properly dispose of pre-filter, decontaminate exterior of machine and seal intake to the machine with 0.15 mm polyethylene to prevent environmental contamination from the filters.

E. The contractor shall patch and paint and repair all damaged areas and restore them to their original, pre-contract condition.

3.32 WASTE DISPOSAL

A. The COTR reserves the right to restrict when containerized ACM will be moved outside of the abatement work area and pass through the building. Times chosen to move containerized ACM in the building shall be during non-public hours and when limited staff is in attendance or under other appropriate conditions as determined by the COTR.

B. Asbestos-contaminated waste that has been containerized shall be transported out of the abatement work area either through the personnel/equipment decontamination enclosure or through a separate waste load-out enclosure. Waste load-out procedures shall be performed by two teams. The team inside the abatement work area shall clean the outside of properly labeled asbestos waste containers using HEPA vacuums and/or wet wiping and place them into the waste load-out enclosure. No personnel from the inside team shall exit any further from the abatement work area. The team inside the waste load-out area (wearing protective clothing and respirators) shall retrieve the waste containers from the load-out enclosure, double-bag the waste and pass them to an uncontaminated area outside the enclosure. No unprotected personnel from the outside team shall enter this enclosure. As applicable, routes to the elevator, the elevator itself, and route to covered carts shall be lined with polyethylene sheeting.

C. For Amosite Fibers: If the material contains amosite fibers, evacuate air from disposal bags with a HEPA vacuum before sealing.

D. Water not disposed of with the asbestos-containing materials shall be filtered to remove asbestos fibers and debris before disposal into sanitary sewer.

E. Do not store containerized materials outside of the abatement work area. Take containers from the abatement work area directly to a sealed truck or dumpster.

F. Bulk and containerized asbestos waste shall be packed, labeled, and transported according to DOT Regulations 49 CFR 173.216 and 49 CFR 173.240. All removed ACM, plastic sheeting, tape, cleaning material, clothing, and all other disposable material or items used in the abatement work area shall be packed into double bagged sealable 0.15 mm plastic bags or double containerized with one bag and one drum. The bags shall be marked with the labels required by OSHA 29 CFR 1910.1001 and/or 1910.1200, and 1926.1101.

1. If the asbestos waste can reasonably be expected to damage double bagged 0.15 mm plastic bags, the following barrel decontamination procedures shall be followed.
    a. Line barrels with a 0.15 mm plastic liner to prevent leaking of contaminated material from the containers.

b. As bags are moved out through the decontamination system, wet wipe bags to remove all contamination from them before they are moved into an uncontaminated space.
c. Place bagged waste into appropriately labeled barrels for transport to landfill.
d. After bagged contaminated waste is placed in barrels, seal lids on barrels.

2. Minimum labeling required:

a. First Label:

==========

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
==========

b. Second Label:

==========
PROVIDE IN ACCORDANCE WITH U.S. DEPARTMENT OF TRANSPORTATION REGULATION ON HAZARDOUS WASTE MARKING. 49 CFR PART 172, SUBPART D: "RQ ASBESTOS NA 2212". PROVIDE A "CLASS 9" LABEL, PER 49 CFR PART 172, SUBPART E.
==========

3. Notify COTR prior to removing each trailer or other waste transport from the jobsite.
4. Notify COTR not less than 48 hours prior to the proposed time of delivery of contaminated waste to the landfill. Owner may elect to observe this operation.
5. The Contractor shall transport the approved sealed drums to an approved waste disposal site.
6. Allow only sealed plastic bags or impermeable containers to be deposited in landfill. Leave damaged, broken, or leaking plastic bags in the impermeable container and deposit entire barrel in landfill.
7. Ensure that there are no visible emissions to the outside air from site where materials and waste are deposited.

G. Contractor shall submit a disposal certificate from the EPA approved landfill confirming final disposal in accordance with EPA standards and regulations before final payment. Retain receipts from landfill or processor for materials disposed of. At completion of hauling and disposal of each load, submit copy of waste manifest, chain of custody form, and landfill receipt to the COTR.

H. The COTR shall provide copies of all hazardous waste disposal manifests to the facility hazardous waste coordinator.

3.33 JOB CLOSE-OUT

A. The Contractor shall submit to the COTR, Post Abatement Drawings to indicate location of the asbestos material removed. If required, the Contractor may edit the Project Drawing to show the actual or additional abatement work completed.

B. The Contractor shall remove from the site all other debris and rubbish resulting from removal and disposal operations and the temporary construction of containment barriers and enclosures.

C. The Contractor shall use positive means to demonstrate to the COTR that any building utilities that were temporarily disabled are now in full service. Notify the COTR when disabled building ventilation, systems, electrical power, smoke detectors, building access/egress passages may safely be re-started or used.

CERTIFICATION OF VISUAL INSPECTION AND FINAL AIR SAMPLING FOR ASBESTOS ABATEMENT

The COTR, Contractor, and SI Industrial Hygienist hereby certify that the abatement work areas have been visually inspected (all surfaces including pipes, beams, ledges, walls, ceiling and floor, plastic sheeting, etc.) and there is no dust, debris, or residue. The COTR also certifies that final air sample results meet abatement work area clearance specifications.

OEDC Project No_____ SI Contract No._____

Project Title/Location_____

_____

Date of Inspection_____

Date and results of final air sample

ASBESTOS ABATEMENT CONTRACTOR
Firm_____
Print Name_____
Print Title_____
Signature_____

SI INDUSTRIAL HYGIENIST
Firm_____
Print Name_____
Print Title_____
Signature_____

SI COTR
Firm_____
Print Name_____
Print Title_____
Signature_____

END OF SECTION 028200

SECTION 028300 – WORK ACTIVITIES IMPACTING LEAD-CONTAINING MATERIALS

PART 1 - GENERAL

1.1 INTRODUCTION

A. The Contractor shall perform all planning, administration, execution, and cleaning necessary to safely perform work activities impacting lead-containing materials (LCM).

B. The approval of or acceptance by the COTR of various work activities or methods proposed by the Contractor does not constitute an assumption of liability either by the COTR or the Smithsonian Institution for adequacy or adverse consequences of said activities or methods.

1.2 WORK INCLUDED

A. Work activities, e.g., demolition, construction, renovation, abatement, and routine maintenance, that will impact lead-containing material, assumed lead-containing material, or other lead-related hazards.

B. General requirements include, but are not necessarily limited to:

1. Notification to regulatory agencies.
2. Regulatory permits, licenses, and approvals.
3. Worker health and safety program.
4. Establishing appropriate engineering controls and utilizing good work practices to prevent migration of lead in air from work areas and properly cleaning work areas prior to release to other tradesworkers, SI employees, the public, etc.
5. Contractor shall be responsible for personnel exposure monitoring as required by regulatory agencies for the safety of its employees as indicated in 29 CFR 1926.62.
6. Contractor shall be responsible for retaining a third-party industrial hygienist to provide project monitoring services during work activities that are subject to this specification section.
7. If required in the project scope of work, abatement of existing lead-containing material.
8. If required in the project scope of work, performing the interim control of existing lead-containing material or lead-related hazards.
9. Transport and disposal of lead-containing or lead-contaminated material.
10. Performance of incidental mechanical and electrical work necessary for conducting the Work.
11. Decontamination and cleaning.
12. Removal of engineering controls, including teardown of containment and decontamination unit.
13. Final job close-out.

C. The Contractor shall review all contract documents and make a site visit to make its own determination about quantity values prior to applying for the required federal, state, or local permits from agencies having authority or jurisdiction.

D. Drawings of the project area and the reference locations within the building may be provided by SI upon request, to assist in the Contractor's planning of the Work for protection of occupants and contents.

E. Work not included:

1. Concurrently with this contract, the Smithsonian Institution reserves the right to collect and analyze samples or retain an independent industrial hygiene firm to provide supplemental sampling services. These services will in no way relieve the Contractor from compliance or liability, nor from providing the testing required by these Specifications, or any other requirements of other agencies with jurisdiction.
2. The Smithsonian Institution has contracted an independent industrial hygiene firm to provide monitoring and testing services. The Contractor shall use a different firm for their personnel exposure monitoring and any other environmental or industrial hygiene related testing performed on this project.

1.3 PERFORMANCE OF WORK

A. Work activities impacting lead-containing material must be conducted by personnel trained and accredited in accordance with state or federal requirements for the location where the work is being performed. At a minimum lead awareness training must be provided in accordance with OSHA Standard 29 CFR 1926.62, Lead in Construction.

B. At a minimum, all renovation, repair and painting work disturbing lead-based paint (LBP), or paint that has not been tested for lead content, in pre-1978 SI-owned/leased facilities, housing and child-occupied facilities, must be conducted in accordance with the requirements of the EPA Final Rule on Lead; Renovation, Repair and Painting Program (RRP) (40 CFR 745) and rule revisions. The rule applies to maintenance and repair activities in which 6 square feet or more of paint is disturbed in a room, or in which 20 square feet or more of paint is disturbed on the exterior. Firms/employers performing this work must be certified by EPA as Lead-Safe Certified Firms. Employees/individuals performing this work must be Certified Renovators who are trained by EPA-approved training providers to follow lead-safe work practices. When a state becomes an EPA-authorized state, firms working in those areas shall contact the appropriate state program office to ensure that applicable training, certification, and work practice requirements are being followed.

C. In addition, firms/employers shall ensure that lead-based paint hazards generated by renovation work are adequately cleaned after renovation work is finished and before the work areas are re-occupied. Visual inspection and dust wipe testing of the work areas after the renovations covered by the RRP rule are required. This clearance examination and dust wipe testing shall be performed by an accredited Dust Sampling Technician, Inspector Technician, or Risk

Assessor in accordance with the regulations. The cleaning verification (CV) card testing option for clearance will not be accepted unless approved by OSHEM.

D. In addition, any work activities impacting lead-based paint in child occupied facilities or target housing, as defined by the District of Columbia, must be conducted by a properly licensed contractor with qualified, trained lead workers and supervisors licensed in the District of Columbia in accordance with the District of Columbia's Lead-Hazard Prevention and Elimination Act of 2008, including Section 8 of the Lead Based Paint Abatement and Control Act of 1996 and properly certified in accordance with the requirements of the EPA Final Rule on Lead; Renovation, Repair and Painting Program (RRP) (40 CFR 745). The District of Columbia currently defines lead-based paint as any paint or other surface coating containing lead or lead in its compounds in any quantity exceeding 0.5% of the total weight of the material or more than one milligram per square centimeter (1.0 mg/cm2), or in any quantity sufficient to constitute a health or environmental hazard.

E. Any renovation, remodeling, repair, or demolition on or around any structure with lead-based paint must be performed by workers with a minimum of 16 hours of Lead-Based Paint Abatement Worker training by an EPA and District of Columbia accredited training provider. In addition, a project supervisor with a minimum of 32 hours of Lead-Based Paint Abatement Supervisor training by an EPA and District of Columbia accredited training provider must be present on site during all aspects of the project work. In addition, all personnel shall possess current lead worker and supervisor licensure from the District of Columbia prior to conducting work activities impacting lead-based paint on the project site, unless a written variance is provided by the local jurisdiction and is approved by the COTR.

1. The contractor or subcontractor to conduct work activities impacting lead-based paint (LBP) shall be an Environmental Protection Agency accredited and/or locally-accredited lead abatement contractor and shall meet the following requirements:
    a. Have a record of not less than five years successful experience in work similar in scope and magnitude to this project.
    b. Maintain one Superintendent, to remain on site at all times that work is in progress. Superintendent must be approved by the COTR prior to the start of the Work and shall not be changed without prior approval from the COTR. Superintendent shall be a Competent Person and Lead Abatement Supervisor as defined in the Specifications and as required by OSHA and EPA. The COTR reserves the right to reject and require replacement of the Superintendent because of lack of required experience, unsatisfactory performance, or if the Superintendent is deemed to be not in the best interest of the project.
    c. Provide one experienced, EPA accredited and locally-licensed lead abatement supervisor Foreman for every eight (8) lead abatement workers utilized on the project. The Foremen shall remain inside the work area at all times that work is in progress and shall direct the work of the lead abatement workers while inside the work area. The COTR reserves the right to reject and require replacement of a Foreman because of lack of required experience, unsatisfactory performance, or if the Foreman is deemed to be not in the best interest of the project.
    d. Use only trained and experienced lead abatement workers and supervisors to perform the Work. All lead abatement workers and supervisors assigned to tasks within the Smithsonian Institution shall be certified and licensed lead abatement workers and/or supervisors through an EPA and state accredited curriculum.

2. Submittals required by Section 1.6 of this specification shall be signed by an EPA accredited and locally-licensed Lead Supervisor or Lead Project Designer.
3. Other work described in the Specifications shall be performed according to applicable codes and standards, federal, state, and local regulations, and the Specifications and drawings.
4. Work activities in SI child-occupied facilities and target housing that impact lead-containing materials must be conducted in accordance with the requirements of the EPA Final rule on Lead, Renovation, Repair and Painting Program (RRP) (40 CFR 745) and rule revisions.

1.4 DEFINITIONS

A. The following definitions pertain to the Work:

1. Abatement: A measure or set of measures designed to permanently eliminate lead-containing material or lead hazards. Abatement strategies include the removal of lead from a substrate, the enclosure of lead, the removal and replacement of building components coated with lead, and the removal of lead-contaminated soil or overlaying of soil with a durable covering such as asphalt.
2. Action Level: The level above which several OSHA requirements are initiated, including, but not limited to: personnel exposure monitoring, medical surveillance, and lead training and education. The current OSHA Action Level is 30 micrograms per cubic meter (□g/m3) calculated as an 8-hour time-weighted average (TWA) without regard to the use of respiratory protection.
3. Airlock: Two curtained doorways spaced a minimum of 1.0 meter apart which form an airlock in the decontamination unit.
4. Air Filtration Unit: A local exhaust unit, utilizing HEPA filtration and capable of maintaining a minimum negative pressure differential of 0.5 mm of water gauge pressure within the containment with respect to that of the surrounding areas. Air filtration units are required in a containment where airborne lead concentrations are expected to exceed the Action Level. The Contractor must submit a negative initial exposure assessment, as required by these Specifications and OSHA, and shall obtain COTR approval when air filtration units are not provided in work areas that typically require local exhaust as an engineering control.
5. Air Monitoring: The process of measuring the airborne lead content of a specific volume of air during a stated period of time.
6. Air Pressure Monitoring: The process of measuring the air pressure differential between the containment interior and the surrounding area using a micromanometer unit.
7. ANSI: American National Standards Institute.
8. ASTM: American Society for Testing and Materials.
9. Authorized Visitor: A person deemed authorized by the COTR to enter the work area during the Work. Authorized visitors are responsible for providing their own respirators, except where noted in these Specifications, and for having received proper training, medical certification, and fit-testing for the respirator used.
10. Breathing Zone: A hemisphere forward of the shoulders with a radius of approximately 15 to 23 centimeters around the nose and mouth of the face.
11. Certified Industrial Hygienist (CIH): A person who is an industrial hygienist certified in Comprehensive Practice by the American Board of Industrial Hygiene.
12. Clean Room: An uncontaminated area or room which is part of the decontamination unit, with provisions for storage of worker's or authorized visitor's street clothing and

protective equipment, and other uncontaminated materials and equipment. The clean room may be used for changing clothes. Extra disposable coveralls and towels can also be stored in the clean room.

13. Cleaning Solution: Solution which contains at least one ounce or five percent trisodium phosphate (TSP) detergent to each gallon of HOT water, or an effective alternate solution approved by COTR.
14. Competent Person: An agent of the Contractor (i.e., the on-site Superintendent/Lead Supervisor) who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and has the authorization by the Contractor to take prompt corrective actions to eliminate them.
15. Contractor: Any business entity, public unit, or person performing the actual work for a LCM abatement or interim lead control project.
16. Containment: A temporary enclosure constructed with 0.15 millimeter (six-mil) thick plastic sheeting, suitable framing, and duct tape and other adhesives within the work area. The containment serves to confine the lead related work activities and to contain the release of airborne lead dust and debris through the action of pressure differential ventilation and air filtration units when required by these Specifications. The only entrance is through the decontamination unit.
17. Contracting Officer's Technical Representative (COTR): An individual representing the Smithsonian Institution as the technical advisor to the Smithsonian Institution's Contracting Officer. This individual may be an employee of the Smithsonian Institution or a consultant.
18. Critical Barrier: Those portions of the containment which represent the minimum structural components necessary to maintain the work area in airtight isolation from the surrounding areas. Examples of openings requiring critical barriers include, but are not limited to: HVAC vents and diffusers, doorways, windows, floor, wall, and ceiling penetrations, and air plenums. If a temporary polyethylene/stud wall must be erected, it shall be treated as a critical barrier. The double-layer polyethylene containment enclosure shall then be erected on that wall. Wrappings on lights, control boxes, etc., do not constitute part of the critical barrier.
19. Curtained Doorway: A passageway to allow access or egress from one room to another while permitting minimal air movement between the rooms of the decontamination unit. It is constructed by placing three overlapping sheets of 0.15 mm (six-mil) poly at least 1.0 meter wide over an existing or temporarily framed doorway. The sheets shall be weighted at the bottom so that they close quickly after being released.
20. Decontamination Unit: A series of connected rooms with curtained doorways between each room, for the decontamination of the workers, equipment and materials. The system is constructed of an air-tight, impermeable, temporary barrier. Framing for the unit shall be metal, fire retardant pressure impregnated wood, or an acceptable substitute approved by the COTR. A decontamination unit for an interior work area contains a minimum of three separate rooms (with airlocks located between the rooms) consisting of an equipment room, wash room, and clean room. A decontamination unit for an exterior work area contains a minimum of two separate rooms consisting of an equipment room and a wash room.
21. Disposal Bag: A properly labeled, minimum 0.15 mm (six-mil) thick, leak-tight poly bag used for transporting lead-containing or lead-contaminated waste from the work area to an EPA-approved disposal site.
22. DOP Penetration Test: An ASHRAE recommended test used to measure the percent penetration (equal to 100 percent minus the percent efficiency) of 0.3 µm DOP (di-octyl phthalate) particles through a filter. A HEPA filter has a minimum efficiency of 99.97 percent as measured using the DOP Penetration Test.

23. DOT: The United States Department of Transportation.
24. Encapsulation: Any covering or coating (encapsulant) that acts as a barrier between existing lead-containing material and the environment, the durability of which relies on adhesion and the integrity of the existing bonds between multiple layers of paint, and between the paint and the substrate.
25. Enclosure: The use of rigid, durable construction materials that are mechanically fastened to the substrate to act as a dust-tight, impermeable, permanent barrier between the lead-containing surface coating and the environment.
26. EPA: The United States Environmental Protection Agency.
27. Equipment Room: A contaminated area or room which is part of the decontamination unit, with provisions for storage of contaminated clothing and equipment and cleaning supplies for decontamination of equipment. Airlocks are required at all entrances to the equipment room.
28. Fixed Object: A unit of equipment or furniture in the work area which cannot be removed from the work area.
29. Hazardous Waste: As defined in EPA regulations, hazardous waste is solid waste or a combination of solid wastes that because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause or significantly contribute to increases in mortality, serious and irreversible or incapacitating but reversible illness, or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed. As defined in the regulations, solid waste is hazardous if it meets one of four conditions: it exhibits a characteristic of hazardous waste; it has been listed as hazardous; it is a mixture containing a listed hazardous waste combined with a non-hazardous solid waste, unless the mixture is specifically excluded or no longer exhibits any of the characteristics of hazardous waste; or it is not excluded from regulation as hazardous waste. Hazardous lead waste is waste that contains greater than or equal to 5 parts per million (ppm) of leachable lead as determined by the toxicity characteristic leaching procedure (TCLP) test, or is waste that is corrosive, ignitable, or reactive and not otherwise excluded.
30. Heat Gun: A device capable of heating lead-containing material causing it to separate from the substrate. The heat stream leaving the gun shall not exceed 590 □C (1,100 □F).
31. HEPA Filter: A High Efficiency Particulate Air filter capable of trapping and retaining 99.97 percent of all mono-dispersed particles 0.3 micrometers in diameter as measured using the DOP Penetration Test.
32. HEPA Vacuum Equipment: HEPA-filtered vacuuming equipment with a filter system capable of collecting and retaining 99.97 percent of all mono-dispersed particles 0.3 micrometers in diameter as measured using the DOP Penetration Test.
33. HUD: The United States Department of Housing and Urban Development.
34. Impact Surface: An interior or exterior surface (e.g., surfaces on doors) subject to damage by repeated impact or contact.
35. Impermeable Waste Disposal Containers: Containers suitable to receive and retain any lead-containing or lead-contaminated material until disposal at an EPA-approved site. The containers shall be labeled in accordance with all applicable regulations and as directed in these Specifications.
36. Initial Exposure Assessment: For each work activity, the Contractor must submit to the COTR air monitoring data, in accordance with OSHA regulations, from a job similar in scope, magnitude, and methods to the Work. The Contractor shall base the following selections on the initial exposure assessment data: level of respiratory and other personal protection equipment, type of washing facilities provided in the decontamination unit according to the Specifications, and the installation of air filtration units in the containment according to the Specifications.

37. Interim Lead Controls: A set of measures designed to temporarily reduce human exposure or possible exposure to lead-hazards. Interim controls include paint film stabilization, encapsulation of lead-containing material, friction and impact surface treatment, dust removal and control, and interim controls of lead-contaminated soil.
38. Lead-Containing Material (LCM): Any material which contains detectable concentrations of lead.
39. Lead-Based Paint (LBP): EPA defines LBP as any paint, varnish, shellac, or other coating that contains lead greater than (>) 0.5 percent by weight as measured by laboratory analysis, or greater than or equal to (>) 1.0 milligrams per square centimeter (mg/cm2), as measured by XRF or laboratory analysis. As state and local jurisdictions may recognize lower concentrations of lead as the definition of LBP, the more stringent, i.e., lower concentration, shall take precedence.
40. Lead Hazard: A condition in which exposure to lead from lead-contaminated dust, lead-contaminated soil, or deteriorated lead-containing surface coatings would have an adverse effect on human health. Examples of lead hazards include the following: deteriorated lead-containing paint, lead dust levels above applicable lead dust standards, and bare lead soil levels above applicable lead soil standards.
41. Lead Supervisor: An OSHA Competent Person with a minimum of three years of lead abatement experience. Must be an EPA accredited supervisor licensed by the appropriate jurisdiction as a lead supervisor. This experienced, accredited, licensed supervisor is required to be present on site full time during all lead work activities.
42. Lead Project Designer: An individual who has been trained by an accredited training program, as defined by Section 745.233 of EPA Title 40 and certified by EPA pursuant to Sec. 745.226 to prepare lead abatement project designs, occupant protection plans, and abatement reports. The project designer shall also be licensed if required by state and local jurisdiction regulations.
43. Lead work activities: Any work activities which may impact or may potentially impact lead-containing material. Examples of work activities include, but are not limited to: renovation, gross demolition, selective interior demolition, removal of building components, abatement, and surface stabilization.
44. Lead work area: Work area where lead work activities are being conducted. The area shall be temporarily demarcated with OSHA approved barrier tape or other physical barriers such as six-mil polyethylene, plywood, etc. The lead work area can also be a “regulated area” if the airborne lead concentrations inside the area are expected to exceed the OSHA Action Level.
45. Microgram (µg): The prefix “micro-” means one millionth of (1/1,000,000 of). A microgram is one millionth of a gram.
46. Mil: Equal to 0.025 mm, or one thousandth of an inch.
47. Milligram (mg): The prefix “milli-” means one thousandth of (1/1,000 of). A milligram is one thousandth of a gram.
48. Movable object: A unit of equipment or furniture in the work area which can be removed from the work area.
49. MSDS: Material Safety Data Sheet.
50. NEC: National Electrical Code.
51. NFPA: National Fire Protection Association.
52. Negative Exposure Assessment (NEA): Air monitoring results which demonstrate that employee exposure during an operation is expected to be consistently below the Permissible Exposure Limit (PEL). The air monitoring and analysis must have been performed in compliance with applicable standards. The data must be from operations performed within the previous 12 months, during operations conducted under workplace conditions “closely resembling” the processes, type of material, control methods, work

practices, and environmental conditions currently used, and conducted by employees whose training and experience are no more extensive than that of employees performing the current job.

53. NIOSH: National Institute for Occupational Safety and Health.
54. OSHEM: The Smithsonian Institution Office of Safety, Health and Environmental Management.
55. Off-site paint removal: The process of removing a component from a building and stripping the paint from the component at an off-site paint-stripping facility.
56. O&M (Operations and Maintenance): Work that will generate or disturb a moderate amount of lead-contaminated dust and debris, but neither the quantities nor the duration of effort that warrants full-scale work area preparation and worker protection. A moderate amount of lead-contaminated dust is clearly visible, may contain debris and paint chips, but will not spread beyond a small area drop cloth to any other surface in the room. Airborne concentrations of lead must be maintained below the OSHA Action Level to be considered as O&M activities. Work classified as O&M includes:
    a. Sawing with manual or power tools up to 0.1 square meter.
    b. Undercutting, rounding or edge-planing one or two painted wood doors using power tools.
    c. Prying open doors, windows, and drawers that have been completely shut around the edges.
    d. Drilling holes, such as those needed to pass rigid conduit through a wall.
    e. Changing hardware on doors or other structural components.
    f. Work techniques that have not been classified, must be submitted and approved by the COTR.
57. OSHA: Occupational Safety and Health Administration.
58. Paint Film Stabilization: An interim control method, consisting of the wet scraping of loose and flaking paint, and priming and repainting surfaces covered with lead-containing material.
59. Patch Test: A test method or procedure to assess the adhesion of an encapsulant to a substrate covered with a lead-containing surface coating.
60. Permissible Exposure Limit (PEL): The level above which special precautions and procedures must be implemented for the protection of personnel within the work area; set by OSHA at 50 □g/m3 calculated as an 8-hour TWA without regard to the use of respiratory protection.
61. Personal Monitoring: Sampling of the airborne lead concentrations within an employee's breathing zone, to determine the eight hour time-weighted average (TWA).
62. Personal Protective Equipment: Equipment for protecting the eyes, face, head, and extremities. Personal protective equipment includes protective clothing, respiratory devices, and protective shields, and is used when hazards capable of causing bodily injury or impairment are encountered.
63. Plastic Sheeting: Plastic sheet material manufactured of polyethylene or polyvinylchloride of specified thickness used for protection of walls, floors, etc., and used to seal openings into the work area. Also known as “poly sheeting” or “poly”. All poly used for Smithsonian Institution projects shall be fire retardant and a minimum of 0.15 mm (six-mil) in thickness.
64. Protection Factor: The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of the degree of protection provided by a respirator to the wearer.
65. Regulated Area: An area established to demarcate areas where airborne concentrations of lead exceed or can reasonably be expected to exceed the OSHA Action level. The

regulated area may take the form of a containment, or an area demarcated by barrier tape or some other physical barrier that controls the number of personnel who may be exposed to lead. Also referred to as the 'Lead Work Area' in these Specifications.

66. Representative Sample: A collection of the various components of an item or group of items in the same proportion as is found in the entire bulk of the item or group of items.
67. Resource Conservation and Recovery Act (RCRA): The primary federal statute governing waste management from generation to disposal. RCRA defines the criteria for hazardous and non-hazardous waste.
68. Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres and approved by NIOSH for a specific category of use.
69. Smithsonian Institution Industrial Hygienist (SI IH): A third party working directly for the Smithsonian Institution with the responsibility for observing and monitoring the activities of the Contractor to document that proper work practices are used and compliance with federal, state, and local laws and regulations is maintained. The SI IH is authorized to collect lead-in-air, bulk paint, lead wipe, lead soil, and TCLP samples during the project, perform visual inspections of the work area, and to make recommendations for the approval of final clearance upon completion of the project to the COTR for approval. The SI IH will, in addition to performing routine and special testing necessary to determine general compliance with the Specifications and Drawings, observe and document, on a daily basis, the execution and progress of the Work. The SI IH is not authorized to direct the Contractor nor to act on behalf of the COTR.
70. Substrate: A surface on which paint, varnish, or other coating has been applied or may be applied. Examples of substrates include wood, plaster, metal, drywall, brick and block, stone, and concrete.
71. Toxicity Characteristic Leaching Procedure (TCLP): A laboratory test used to determine if excessive concentrations of lead or other hazardous materials could leach from a sample into groundwater; usually used to determine if waste is hazardous based on its toxicity characteristics.
72. Time-Weighted Average (TWA): The average air concentration of contaminants during a particular sampling period. The most common sampling period utilized in abatement work is eight hours, giving rise to the eight hour time-weighted average quoted in many governing regulations.
73. Trisodium Phosphate (TSP) detergent: A detergent that contains trisodium phosphate.
74. Washroom: A room between the equipment room and the clean room in the decontamination unit for employee and equipment decontamination containing either shower or hand washing facilities. The washroom shall contain shower facilities at all times that the airborne lead concentrations exceed or are expected to exceed 50 µg/m3 inside the work area; the washroom shall, at a minimum, contain hand washing facilities when airborne lead concentrations are not expected to exceed 30 µg/m3 inside the work area. The washroom comprises an airlock. The Contractor shall submit a negative initial exposure assessment as required by these Specifications and OSHA, and shall obtain COTR approval when shower facilities are not provided in the washroom.
75. Whole Component Removal and Replacement: A work activity that entails the removal of building components coated with lead-containing surface coatings (e.g., windows, doors, trim, etc.) and the installation of components free of lead.
76. Wet Cleaning: The process of eliminating loose lead-containing surface coatings from building surfaces and objects by using cloths, mops, or other cleaning tools dampened with water and TSP or other similar detergent. These cleaning tools shall be disposed of as lead-contaminated waste.

77. Window Sill: The portion of the horizontal window ledge, adjacent to the window sash when the window is closed, that protrudes into the interior or the room or from the exterior of the window; sometimes called the 'window stool'.
78. Window Trough: For a typical double-hung window, the portion of the exterior window sill between the interior window sill and the frame of the storm window. If there is no storm window, the window trough is the area that receives both the upper and lower window sashes when they are both lowered; sometimes called the 'window well'.
79. XRF Analyzer: An instrument that determines lead concentration in milligrams per square centimeter (mg/cm2) using the principle of x-ray fluorescence (XRF).

1.5 CODES, REGULATIONS AND REFERENCES

A. A.The Contractor acknowledges, by execution of the Contract, its awareness and familiarity with the contents and requirements of the following regulations, codes, standards, and guidance documents and assumes responsibility for the performance of the Work in strict compliance with these documents and for every instance of failure to comply with these documents. The current issue of each document shall govern. Where conflict exists between these documents and the Contract Documents, the more stringent requirements shall apply.

B. The Contractor shall comply with the most current edition of all federal, state, county, and city codes and ordinances as applicable and shall make available for review at the site one copy of all applicable federal, state, county, and city regulations governing the Work, including, but not limited to:

1. OSHA:
   a. 29 CFR 1910 General Industry Standards
   b. 29 CFR 1910.1025 Lead Standard for General Industry
   c. 29 CFR 1910.134 Respiratory Protection
   d. 29 CFR 1910.1200 Hazard Communication
   e. 29 CFR 1910.245 Specifications for Accident Prevention
   f. 29 CFR 1926 Construction Industry Standards
   g. 29 CFR 1926.62 Construction Industry Lead Standard
   h. 29 CFR 1926 Subpart L-Scaffolds
   i. 29 CFR 1926 Subpart M-Fall Protection
2. United States Environmental Protection Agency:
   a. 40 CFR Part 260-279 Standards for the Management of Hazardous Waste
   b. 40 CFR Part 745 Lead-Based Paint Activities Regulation
3. United States Department of Transportation (DOT):
   a. 49 CFR Parts 171-172 Hazardous Materials Regulations
4. 4. United States Department of Housing and Urban Development (HUD):
   a. 24 CFR Parts 35, 36, 37 HUD Lead-Based Paint Regulations
      1) “Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing”
5. National Institute of Building Sciences: Lead-Based Paint: Operations and Maintenance Work Practices for Homes and Buildings
6. All state requirements which govern lead abatement or interim control work, or hauling and disposal of hazardous waste materials and the following District of Columbia requirements:
   a. 20 DCMR 806, Control of Lead

b. DC Act 11-438
c. DC "Lead-Hazard Prevention and Elimination Act of 2008"

7. All local requirements which govern lead abatement or interim control work or hauling and disposal of hazardous waste materials.
8. Codes and Standards:
   a. American Society for Testing and Materials (ASTM)
   b. American National Standards Institute (ANSI)
   c. National Institution for Occupational Safety and Health (NIOSH)

1.6 SUBMITTALS

A. The Contractor shall submit three (3) complete sets of Pre-Job Submittals to the COTR for review at least ten (10) working days prior to commencement of mobilizing or three (3) working days prior to the pre-construction meeting, whichever is earlier. The Work may not proceed until the complete pre-job submittal package has been reviewed and approved by the COTR. The Contractor shall bind pre-job submittals in a three-ring binder with dividers keyed to the following items:

1. A Plan for the Work for approval by the COTR. The Contractor's Work Plan shall be prepared in accordance with OSHA and other applicable regulations, and shall include the following, as a minimum:
   a. A description of specific control methods to be utilized in performing the Work. This shall include all engineering and work practice controls to be utilized during the Work. Contractor must indicate what type of washing facilities (i.e., showers or hand washing) will be installed and if negative pressure will be created in the containment as required by these Specifications. The work plan shall be specific for each type of work activity impacting lead. Negative Exposure Assessment (NEA) information associated with these activities must be submitted, if the contractor wants to rely on the NEA data with SI's approval.
   b. A preliminary bar chart schedule of the Work. The schedule shall include all work, both on and off the job site, for the entire contract period.
   c. A layout sketch of the decontamination unit and each work area. Describe assembly of construction, materials to be used and location of notices to be posted on the job site. Indicate which areas will be sealed off and by what means. Show locations of facilities and equipment such as showers, lockers, storage, etc. Show locations of all filtration devices to be used, their exhaust locations, and the calculations to determine the number of devices needed to provide air circulation as required in these Specifications.
   d. A written description of methods to isolate/restrict access to the work areas. Indicate how access will be controlled, how building HVAC ventilation systems will be isolated from the work area, and how security and fire systems will be maintained within the work area. Include plans for electrical lock-out and dedicated electrical systems. These requirements shall be coordinated with the COTR and the facility representative.
2. A list of specific protective clothing and equipment to be utilized during the Work.
3. A written respiratory protection plan which includes the following:
   a. An initial exposure assessment as defined in these Specifications and required by OSHA. The Contractor shall base the following selections on the initial exposure assessment data: level of respiratory and other personal protection equipment, type

of washing facilities provided in the decontamination unit as required by these Specifications, and the installation of air filtration units in the containment.

b. A proposed respiratory protection schedule indicating the specific respiratory equipment selected for use during the Work

c. Technical data on the different types of respirators to be used in accomplishing the Work. Include model numbers and tested/certified (TC) numbers issued by NIOSH and MSHA.

d. The Contractor's written respiratory program as required by OSHA. The written respiratory program shall provide evidence that each employee assigned to this project is medically certified to wear respiratory protection, has been successfully fit tested, and participates in the respiratory program.

4. A list of all project personnel, both on-site and office, and a statement of their responsibilities and authority for work on this project.

5. The following documentation for each and every employee assigned to the project by the Contractor or subcontractor, regardless of their role on the project. Submit this information as one package per employee, arranged alphabetically.

   a. A copy of their EPA accreditation and licensure by the appropriate jurisdiction as a Lead Worker or Supervisor when impacting lead-based paint surfaces or when airborne lead concentrations are expected to exceed the OSHA PEL.

   b. A copy of the physician's most recent written medical opinion indicating that the worker is fit to perform the Work and wear the assigned respiratory protection device.

   c. Documentation per OSHA 1926.62(1), that shows that the employee has received and understands instruction on the hazards of lead exposure, personal protective equipment usage, use of decontamination showers and hand washing facilities, the procedures for entering and exiting the work areas, the purpose of the medical surveillance and medical removal programs, and on all aspects of the work procedures and protective measures to be used on this project.

   d. An abbreviated resume that states the experience, qualifications, training, and currently held lead licenses for the on-site Superintendent and all Foremen assigned to the project. Furnish documentation that the Superintendent is a Competent Person as defined in these Specifications

6. A copy of the notice of impending lead work activities in writing to the appropriate agencies. If not required, so state by means of a letter of explanation signed by a company officer.

7. Current licenses and permits required by applicable Federal, state, and local jurisdictions for the lead- work activities, transportation and disposal of waste, or other regulated activity relative to the Work.

8. An insurance certificate issued to COTR by the Contractor's insurance carrier listing all coverage as specified in the General Conditions.

9. Copies of Contractor's Certifications and Licenses.

10. Information on the site location and arrangements for transporting and disposal of lead-containing or lead-contaminated waste. Include the following as a minimum:

    a. The landfill selected for disposing of the lead-containing or lead-contaminated waste. Include: owner, operator, address, and telephone number of the landfill.

    b. Landfill certification that shows that the selected landfill is permitted by a state or federal agency to receive lead waste.

    c. Landfill certification that shows that the selected landfill will accept the lead waste.

    d. Name of the disposal subcontractor. If a disposal subcontractor will not be used, so state.

e. The waste transporter's certificate of insurance and registration with the EPA. If the Contractor will be transporting the waste, then it shall submit its certification of insurance and registration with the EPA as a licensed Waste transporter.
f. All required permits for the transport and disposal of lead waste. If no permits are required, so state by means of a letter of explanation signed by a company officer.

11. Building permits required for the lead abatement and interim control, construction, or demolition work during the progress of the Work. If no permits are required, so state by means of a letter of explanation signed by a company officer.
12. A written description and sketch of the site specific Security Plan to be utilized on this project.
13. A written Contractor Health and Safety Program specifically designed for this project with evidence of comprehension of this Health and Safety Program by the employees assigned to this project.
14. An Emergency Plan which addresses the Contractor's responses to the following: fire, accident, power failure, pressure differential system failure, supplied air system failure, or any other event that may require modification or abridgment of decontamination or work area isolation procedures. Show primary and secondary exit routes from the building, locations of the nearest manual pull stations, telephone number of the Smithsonian Institution Security Office, name of the Contractor's designated employee responsible for fire protection, fire hazards inherent to the project, and measures taken for prevention.
15. Evidence that all employees assigned to this project are familiar with the Emergency Plan, know how to activate the fire alarm, and are trained in the use of portable fire extinguishers; one on-site employee shall be designated as responsible for fire protection. The plan shall be maintained and available at the job site, and the following emergency information shall be posted at all entrances to the work area: the exit route map, and the phone number of the Smithsonian Institution Security Office.
16. Manufacturer's literature and written information for all materials and equipment, including encapsulants, primers, and paints. Submit NFPA and ASTM test reports of fire retardant materials, and MSDSs for all chemical-content supplies. Contractor shall not change materials or equipment without approval of a new submittal by the COTR.
17. Copies of notices, signs, and lead caution barrier tape to be posted at the job site, as required by the State, EPA and OSHA regulations for lead work activities.
18. A specimen of the Sign In/Sign Out Log showing the following as a minimum: date, name, social security number, entering and leaving time, company or agency represented and reason for entry for all persons entering the work area.
19. The name and qualifications of the Contractor's industrial hygiene consultant and analytical laboratory for performing personal air monitoring and analysis, as required by OSHA regulations.
20. The qualifications of the Contractor's employee blood monitoring services as required by OSHA regulations.
21. A description of any special techniques, equipment, etc., to be used on the project. If none, so state.

B. The Contractor shall correspond with the COTR for all matters related to this project, unless otherwise directed. All correspondence with the Smithsonian Institution shall be in the English language, signed, and dated by the Contractor.

1. The Contractor shall maintain results at the job site from personal air monitoring and make them available to the COTR for inspection upon request.

2. The Contractor shall maintain daily reports using the Smithsonian Institution Contractor's Daily Report form. Reports shall be numbered consecutively, and all sections shall be completed or noted as 'not applicable'. Each day's report shall contain detailed remarks including, but not limited to: progress on the job, problems discovered, and discussions with the Smithsonian Institution's staff. Reports shall be submitted to the COTR each day for the previous work day. Copies shall be maintained at the job site and made available to the COTR upon request.
3. The Contractor shall submit to the COTR revised project schedules and manning schedules for the Work as changes mandate.
4. The Contractor shall report all accidents immediately to the Smithsonian Institution Security Office, then to the COTR. Prepare reports of significant accidents, at site and anywhere else work is in progress. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury is sustained, property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury. Report shall be submitted to the COTR, who will forward copies to OSHEM and the facility Safety Coordinator.
5. When an event of unusual and significant nature occurs at the site (e.g., failure of pressure differential system, rupture of temporary enclosures, equipment or power failure), the Contractor shall prepare and submit a special report to the COTR listing the chain of events, persons participating, response by the Contractor's personnel, evaluation of results or effects, and similar pertinent information.

C. Post-Job Submittals:

1. A comprehensive listing of personal air monitoring results taken in compliance with the OSHA regulations.
2. A completed copy of the Waste Control Log.
3. Submit, to the COTR, (who is to forward copies to the facility hazardous waste coordinator) copies of the following hazardous waste records for waste generated on SI property and disposed by contract personnel:
    a. Hazardous Waste Manifests (signed by the SI facility hazardous waste coordinator, the waste transporter, and the disposal site)
    b. Proof of recycling for lead coated metals
    c. Notification and Certification Forms
    d. Material Profile Sheet or Characterization
    e. Container Content Sheet
    f. Certificate of Disposal
4. Copies of the completed Sign In/Sign Out Logs showing the following as a minimum: date, name, social security number, entering and leaving time, company or agency represented, and reason for entry for all persons entering the work areas.
5. An alphabetical listing of all employees used on the project and the exact dates on which they were present in the work areas.
6. For each employee that worked on this project, submit a notarized letter stating that blood monitoring has been performed for the employee as required by OSHA and the Specifications.
7. Affidavit of Release of Liens.
8. Certificate of Completion.

1.7 GENERAL INFORMATION REGARDING LEAD WORK ACTIVITIES

A. Work activities impacting lead that are assumed to expose employees above the OSHA PEL:

1. Manual demolition of structures, which includes interior selective demolition;
2. Dry, manual scraping and sanding;
3. Using a heat gun; and
4. Power tool cleaning with dust collection systems.

B. Contractor shall be responsible for maintaining surfaces free of dust, debris, and paint chips in areas outside of the lead work area where employees decontaminate, eat, or take rest breaks. In addition, egress routes to and from the lead work areas to the exterior of the building must also be free of dust, debris, and paint chips.

C. Non-lead work areas, decontamination areas, and break areas must be pre-cleaned of all visible dust, debris, and paint chips using wet wiping, sweeping, or mopping techniques with TSP or equivalent detergent. If a vacuum is to be utilized, it must be properly equipped with a HEPA filter and be designed for use on abatement projects.

D. Wet sweeping, brushing, or mopping shall only be used in circumstances where vacuuming or other equally effective methods have been tried and found not to be effective as determined by the COTR.

E. Under no circumstances shall dry sweeping, compressed air, or vacuums without HEPA filters be used to clean surfaces of dust, debris, or paint chips inside lead work areas.

F. Contractor may reduce engineering controls, worker personal protection, and training requirements with the permission of the COTR only if they can successfully establish a negative exposure assessment (NEA) in accordance with OSHA Standard 29 CFR 1926.62, paragraph (d) Exposure Assessment and these additional requirements:

1. Personal exposure air sample data must be presented from a minimum of three work shifts for each work activity or task that will be represented.
2. The personal exposure data used as a NEA must be representative of, at a minimum, 25% of the crew performing the work activity and collected during activities that would most likely generate the highest concentrations of airborne lead dust.
3. The work practices and engineering controls utilized during the NEA must be documented in detail and approved by the COTR prior to being used as valid NEA data.

PART 2 - PRODUCTS

2.1 PRODUCT HANDLING

A. The Contractor shall ensure that all materials are delivered in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name, complete with labels and instructions for handling, storing, unpacking, protecting and installing.

B. Contractor shall schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

C. The Contractor shall coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

D. The Contractor shall inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that the products are undamaged and properly protected.

E. The Contractor shall store all materials subject to damage off the ground, away from wet or damp surfaces, under cover sufficient to prevent damage or contamination.

F. The Contractor shall remove from the premises all damaged or deteriorated materials. Dispose of materials that become contaminated with lead in accordance with applicable regulatory standards and these Specifications.

2.2 MATERIALS

A. Any substitution in materials or methods to those specified shall be approved by the COTR prior to use. Any requests for substitution shall be provided in writing to the COTR. The request shall clearly state the rationale for substitution.

B. Chemical Stripping Agent Neutralizer: Chemical stripping agent neutralizers may be used on compatible surfaces only, according to the manufacturer’s instructions. Neutralizers shall be compatible with and not harmful to the substrate to which they are applied. Neutralizers shall be compatible with the stripping agent that has been applied to the surface substrate.

C. Chemical Stripping Removers: Chemical removers shall contain no methylene chloride products. Chemical removers shall be compatible with, and not harmful to, the substrate to which they are applied. Chemical removers used on masonry surfaces shall contain anti-stain

formulation that inhibits discoloration of stone, granite, brick and other masonry construction. Chemical removers used on interior surfaces shall not raise or discolor the surface being treated.

D. Cleaning Solution: Provide detergent or cleaning agent formulated to be effective in removing lead dust. Follow dilution ratio recommended by the manufacturer's instructions.

E. Encapsulant: Acrylic-based primer and top coat. Primer shall be compatible to the substrate. Acceptable manufacturers shall be pre-approved by the COTR.

F. Impermeable Containers: Shall be suitable to receive and retain lead-containing or lead-contaminated materials until disposal at an approved site, and shall be labeled in accordance with OSHA, EPA and DOT regulations. Containers shall be both air and water tight. Use two types of impermeable containers:

1. Plastic, metal, or fiber drums with tightly fitting lids, lined with 0.15 mm (six-mil) poly; and,
2. 0.15 mm (six-mil) poly bags sized to fit within the lined drums.

G. Plastic Sheeting: Polyethylene plastic material a minimum of 0.15 mm (six-mil) in thickness for covering floors and walls, providing air locks, and sealing doors and windows; supply in appropriate widths to minimize seams. Must be fire retardant, meeting NFPA/ASTM criteria. Reinforced sheeting is required for applications subject to wear and tear.

H. Surfactant (Wetting Agent): Mixture of "Dust-Set Amended Water Base" and water, mixed to the manufacturer's Specifications.

I. Tape: Tape shall be glass fiber or other type capable of sealing joints of adjacent sheets of poly and for attachment of poly sheeting to finished or unfinished surfaces under both dry and wet conditions.

J. Warning Labels and Signs: as required by OSHA.

K. Wood: Must be pressure-impregnated, fire retardant lumber.

L. The Contractor shall provide all other materials (e.g., nails, hardware, etc.) which may be required to construct and dismantle the decontamination system and the barriers that isolate the work area.

2.3 TOOLS AND EQUIPMENT

A. The Contractor shall provide air filtration units that are factory-sealed and equipped with HEPA filters (final), intermediate filters, pre-filters, instrumentation to monitor pressure differential, and safety and warning devices.

1. Units shall be equipped with electrical components approved by the National Electrical Manufacturers Association (NEMA) and Underwriter's Laboratories (UL).
2. Access to the units for replacement of all air filters shall be from intake end. Provide units with pre-filters and intermediate filters installed either on or in the intake grid of the unit and held in place with special housings or clamps. The filter media shall be completely sealed on all edges with a structurally rigid frame with a continuous rubber gasket.
3. Provide units equipped with HEPA filters. Filters shall be individually tested and certified by the manufacturer.
4. Provide a two-stage pre-filtration system to extend the life of the primary HEPA filter. The first-stage pre-filter shall be a low-efficiency type effective for particles 100 micrometers and larger. The second-stage (or intermediate) filter shall have a medium efficiency effective for particles down to 5 micrometers.
5. Where negative pressure enclosures are required on projects, provide units equipped with a magnehelic gauge or manometer to measure the pressure drop across filters and to indicate when filters have become loaded and need to be changed. A table indicating the usable air-handling capacity for various static pressure readings on the magnehelic gauge and the magnehelic reading indicating at what point the filters should be changed, noting quantity of air delivery at that point, shall both be affixed near the gauge for reference. Provide an elapsed time meter to show the total accumulated hours of operation.

B. The Contractor shall equip all circuits for any purpose entering work area with ground fault circuit interrupters (GFCIs). Locate GFCIs exterior to work area so that all circuits are protected prior to entry to the work area. Provide circuit breaker type GFCIs equipped with test button and reset switch for all circuits to be used for any purpose in work area, decontamination unit, exterior, or as otherwise required by applicable regulations. Locate the panel exterior to the work area.

C. The Contractor shall comply with the applicable recommendations of NFPA's "Standard for Portable Fire Extinguishers". Locate fire extinguishers where they are most convenient and effective for their intended purpose.

D. Electrically-operated heat guns shall be flameless electrical paint softener type. Heat gun shall have electronically controlled temperature settings to allow usage below a temperature of 5900 C (1,100º F). The heat gun shall be DI type (non-grounded) 120 V, AC application. The heat gun shall be equipped with various nozzles to cover all common applications.

E. Machine Sanding Equipment shall be the dual action, rotary action, orbital or straight line system type, fitted with HEPA filters. Air compressors utilized to operate this equipment shall be designed to continuously provide adequate pressure as required by the manufacturer.

F. Powered Air Purifying Respiratory (PAPR) equipment shall be approved by NIOSH, and equipped with HEPA filters.

G. The Contractor shall have available power cables or sources such as generators, where required.

H. Scaffolding, as required to accomplish the Work, shall meet all applicable safety regulations (29 CFR 1926, Subpart L).

I. The Contractor shall provide sufficient temporary lighting to ensure proper workmanship everywhere; by combined use of daylight, general lighting, and portable plug-in-task lighting.

J. The Contractor shall provide transportation, as required, for loading, temporary storage, transit, and unloading of contaminated waste without exposure to persons or property. Use only enclosed or covered trucks to haul waste containers to prevent loss or damage of containers in route to the landfill.

K. Vacuum units, of suitable size and capacities for the Work, shall be equipped with HEPA filters.

L. The Contractor shall utilize airless or low pressure water sprayers or hand-held spray bottles for amended water application.

PART 3 - EXECUTION

3.1 ACCESS TO WORK AREAS

A. Access to the areas where lead work activities are occurring shall be restricted to the Contractor's workers and authorized visitors, as defined in these Specifications.

B. Authorized visitors shall have access to the work site at all times, following notification to COTR. The Contractor shall supply protective clothing and equipment for authorized visitors, as necessary, except for respirators, which shall be provided by the authorized visitor in accordance with these Specifications.

C. Signage for work areas where airborne lead concentrations are known or expected to be above the OSHA Action Level: The Contractor shall prominently post signs at all entry points to the work area which clearly warn that lead abatement or interim control work is being conducted in the vicinity. Immediately inside entry point and outside critical barriers post a warning sign meeting OSHA specifications. Minimum sign size shall be 500 mm by 350 mm displaying the following legend:

WARNING

LEAD WORK AREA

POISON

UNAUTHORIZED ENTRY PROHIBITED

NO SMOKING, EATING OR DRINKING PERMITTED IN THIS AREA

Signs shall be in bold lettering a minimum of 50 mm tall.

D. Signage for lead work areas where airborne lead concentrations are known or expected to be less than the OSHA Action Level: Demarcate work area perimeter with caution tape. At entrance or along perimeter, post signs per OSHA with the following legend:

WARNING

LEAD WORK AREA

POISON

NO SMOKING, EATING, OR DRINKING

E. Required signage shall be posted immediately outside all entrances and exits to the lead work area at least 3 days in advance of work except, that in emergency situations, posting shall be done as soon as possible.

F. Where required, all workers and authorized visitors shall enter the work area through the decontamination unit only, in accordance with these Specifications.

G. Before entering the work area, all workers and authorized visitors shall read and be familiar with all posted regulations, personal protection requirements, and emergency procedures and exit routes.

H. The Contractor shall maintain a daily job site personnel log listing names and social security numbers of individuals who entered the work area, and the times of entering and leaving the work area.

3.2 WORKER AND VISITOR PROTECTION

A. No eating, drinking, smoking, or chewing gum is permitted within the work area. The COTR shall designate a “break area” where these activities, except for smoking, are permitted. Smoking is not permitted in Smithsonian Institution facilities.

B. Workers and authorized visitors shall be fully protected with respirators and protective clothing during any work that may disturb lead-containing material, and which results or may result in airborne concentrations of lead greater than the OSHA PEL. Full protection is not required during pre-abatement inspections of the work area, before abatement or interim control work has begun.

C. The Contractor shall provide workers and authorized visitors with sufficient sets of protective full-body clothing. Such clothing shall consist of full body coveralls, headgear, foot protection, and gloves. Provide eye protection and hard hats as required by applicable safety regulations. Contractor shall have a minimum of six (6) sets of disposable protective full body clothing for COTR and authorized visitors for each work day. Street clothes may not be worn into an abatement or interim control work area. Provide storage facilities for authorized visitor's and worker's street clothing in the clean room. Workers must wear nylon shorts, ‘TYVEK’ shorts, or an acceptable substitute, under disposable suits.

1. Provide non-skid type work boots with protective shields as required by OSHA.
2. Provide hard hats that meet ANSI requirements for use where work is overhead, scaffolding is being used, or as otherwise required by OSHA.

3. Provide goggles that meet ANSI requirements as required by OSHA.
4. Provide disposable work gloves for use in the work area.
5. Provide disposable coveralls with hoods for use in the work area.

D. Contaminated, non-disposable clothing and footwear shall be stored in a controlled area adjacent to the work area until the completion of the Work. Upon completion of work such items shall be thoroughly decontaminated of all lead-containing or lead-contaminated material or disposed of as lead-contaminated waste.

E. The Contractor shall provide washing facilities to be used by all workers for all work impacting lead-containing materials. All Lead work sites must have washing facilities.

1. Washing facilities shall contain a temporary sink with both hot and cold water. Filter all water as required in these Specifications or dispose of as lead-contaminated waste.
2. Supply a sufficient quantity of soap and towels for the workers and authorized visitors.

F. The Contractor shall provide pre-fabricated or site-built shower facilities to be used by all workers when lead in air concentrations exceed or are expected to exceed 30 □g/m3. The Contractor must submit a negative exposure assessment and obtain COTR approval when shower facilities are not provided.

1. Showers shall have both hot and cold water which can be controlled from inside shower. Filter all shower water as required in these Specifications or disposed of as lead-contaminated waste.
2. Supply a sufficient quantity of soap and towels for the abatement workers and authorized visitors.

G. The Contractor shall provide suitable emergency eye flushing facilities within the work area when the eyes of employees may be exposed to injurious corrosive materials or according to OSHA requirements.

H. The Contractor shall provide medical surveillance for all workers according to OSHA requirements.

I. All workers must have baseline and post work blood lead level measurements determined by the whole blood lead method. A worker shall not be permitted to work on the project when three baseline blood sampling tests average greater than 25 □g/dL or if a single test exceeds 30 □g/dL. A formal investigation shall occur whenever a worker's post-work blood lead level rises more than 10 □g/dL above the baseline level.

J. The Contractor shall assure that in areas where employees are exposed to lead above the PEL without regard to the use of respiratory protection, the following hygiene facilities and practices be followed:

1. Clean change areas shall be provided by the Contractor for employees whose airborne exposure to lead is above the Action Level, and as interim protection for employees

performing tasks as specified in paragraph (d)(2) of OSHA Standard 29 CFR 1926.62, without regard to the use of respirators;

a. Change areas shall be equipped with separate storage facilities for protective work clothing and equipment and for street clothes, which prevent cross-contamination.
b. The employer shall assure that employees do not leave the workplace wearing protective clothing or equipment that is required to be worn during the work shift.

2. The Contractor shall ensure that eating areas are as free as practical from lead contamination by;
   a. Assuring that employee wash their hands prior to eating, drinking, smoking, or applying cosmetics.
   b. Not permitting employees to enter eating areas with protective clothing or equipment.
3. Hand washing facilities shall be provided by the Contractor for use by employees exposed to lead in accordance with OSHA Standard 29 CFR 1926.51(f). Where showers are not provided, the Contractor shall assure that employees wash their hands and face at the end of the work shift.

K. Personnel exiting the lead work areas shall use the following decontamination procedures, unless otherwise specified herein:

1. Vacuum off work clothes with HEPA filter equipped vac
2. Remove disposable, protective clothing and place in an OSHA approved impermeable disposal bag
3. Clean exposed skin such as the face, hands, and arms, either in a shower or similar washing facility
4. Change into clean clothing prior to leaving the physical boundary designated around the work area.

3.3 RESPIRATORY PROTECTION

A. The Contractor shall instruct and train each worker involved in the Work in proper respiratory use and require that each worker wear a respirator properly during all operations which may expose the worker at or above the permissible exposure limit (PEL). Respiratory protection shall be used until the work area is completely decontaminated and final clearance testing has been performed and approved by the COTR.

B. The Contractor shall certify that all workers using respiratory protection have been medically approved to use respiratory protection.

C. The Contractor shall select respiratory protection appropriate for the lead levels encountered in the work area as outlined in OSHA regulations and these Specifications, or as required for other toxic or oxygen-deficient situations encountered. Respirators shall be selected from among those approved by NIOSH.

D. The Contractor shall select and provide respirators to each employee and shall ensure that the employee uses the respirator provided. Allow each employee to use only those respirators for which training and fit-testing have been provided. Require that each time an air-purifying

respirator is put on it is checked for fit with a positive and negative pressure fit check in accordance with OSHA regulations (29 CFR 1910.134). Quantitative/qualitative fit-testing shall be repeated at least annually, and at any time a respirator is replaced.

E. Authorized visitors are responsible for providing their own respirator and replacement filters and cartridges, with the exception of Full-Face, Supplied Air Respirators Operating in Pressure Demand Mode which shall be provided by the Contractor. Authorized visitors are also responsible for having received proper training, medical evaluation, and fit-testing for the respirator used.

F. The Contractor shall provide, for use with air-purifying respirators, HEPA-type filters certified by NIOSH for protection against lead dust. Negative-pressure, particulate filters will meet the requirements of 40 CFR Part 84 following its effective date (July 10, 1998). A sufficient quantity of HEPA filters shall be supplied such that workers may change filters at any time that flow through the face piece decreases to the level at which the manufacturer recommends filter replacement or when breathing resistance is occurring. In addition, a chemical cartridge must be added, as required, for protection against chemicals used for the Work.

G. The following respirators are permitted for use for the airborne lead dust levels specified:

1. Half-Face, Air Purifying Respirators equipped with HEPA filters for airborne lead dust concentrations not in excess of 500 □g/m3 (10 times the PEL).
2. Full-Face, Air Purifying Respirators equipped with HEPA filters for airborne lead dust concentrations not in excess of 2,500 □g/m3 (50 times the PEL).
3. Powered Air Purifying Respirators (PAPRs) equipped with HEPA filters for airborne lead dust concentrations not in excess of 2,500 □g/m3 (50 times the PEL).
4. Full-Face, Supplied Air Respirators Operating in Pressure Demand Mode is required when airborne lead dust concentrations are expected to meet or exceed 100,000 □g/m3 (2,000 times the PEL).

H. Contractor shall not use or allow the use of any single-use, disposable, or quarter-face respirators or any other respirator not approved for use by NIOSH.

3.4 LEAD MONITORING, TESTING, AND ANALYSIS PROCEDURES

A. Laboratories used to conduct lead analyses shall participate in the EPA's National Lead Laboratory Accreditation Program (NLLAP).

B. Inspections and risk assessments performed in SI-owned housing shall be conducted in accordance with HUD's "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing", Chapters 5 and 7, and 40 CFR 745

C. Sampling for lead-in-paint shall be performed by persons trained and licensed by the appropriate state and local agencies to perform lead inspections. Sampling shall be performed

generally following the protocols included in HUD's "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing", Chapter 7 – 1997 version using either an XRF Lead Paint Analyzer or by bulk paint chip sampling. Analysis of bulk paint chips for lead shall be performed by an accredited laboratory using either Flame Atomic Absorption Spectroscopy (FLAA) or by Inductively Coupled Plasma (ICP).

D. Sampling for lead-in-air shall be performed generally following the "Sampling Airborne Particulate for Lead (NIOSH Method 7082)" procedure as outlined in HUD's "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing". Analysis of lead-in-air samples shall be performed by an accredited laboratory using either FLAA or ICP methods.

E. Lead dust wipe sampling shall be performed generally following the ASTM method E1728 or "Wipe Sampling for Settled Lead-Contaminated Dust" procedure as outlined in HUD's "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing". Analysis of lead wipe samples shall be performed by an accredited laboratory using FLAA following NIOSH Modified Method 7082 or by ICP following Modified OSHA Method ID-125.

F. Lead-in-soil sampling shall be performed generally following the procedures outlined in HUD's "Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing". Analysis of soil for lead shall be performed by an accredited laboratory by FLAA or ICP.

G. Bulk samples of waste for TCLP analysis shall be representative samples of the waste and shall be collected following the procedure indicated by the selected laboratory performing the TCLP analysis. TCLP analysis of representative samples of lead-containing or lead-contaminated waste shall be performed by an accredited laboratory following EPA Method SW-846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods". TCLP samples shall be collected by the SI IH.

3.5 BASELINE TESTING

A. Settled lead dust wipe samples will be collected in interior and exterior work areas by the SI IH prior to Contractor mobilization to the site, construction of the containment area, or any pre-cleaning activities. Baseline lead dust samples will be collected from representative components in the area, and will, at a minimum, include one sample from the following: floor inside the work area, floor outside the work area at the location of the containment entrance, and one window sill and one window trough inside the work area (actual number and specific locations of samples shall be determined by the SI IH).

B. Lead-in-soil sampling will be performed in the area adjacent to exterior work areas by the SI IH prior to Contractor mobilization to the site, construction of the work area, or any pre-cleaning activities. Baseline lead soil samples will be collected by composite sampling of areas adjacent to each exterior work area (actual number and specific locations of samples shall be determined by the SI IH).

3.6 AIR AND DUST MONITORING

A. The Contractor shall be responsible for performing personal air monitoring as required by OSHA during the Work. The results of such monitoring shall be posted, provided to individual workers, and submitted to the COTR as required in these Specifications.

B. The SI IH will perform airborne lead monitoring on a daily basis for the duration of the work both inside and outside the work area.

1. The Contractor shall utilize work practices and engineering controls that limit the quantity of airborne lead dust inside the work area. The Contractor shall strive to maintain airborne lead concentrations inside the work area below the OSHA Action Level.
2. If any air sample taken outside of the work area exceeds the Action Level of 30 □g/m3, the Contractor shall immediately stop all work except corrective actions. The SI IH and the Contractor Superintendent will determine the source of the airborne lead.

C. The SI IH will be performing lead dust sampling at the beginning of the Work and periodically thereafter at the area immediately adjacent to the entrance of each decontamination unit. Results of lead dust samples will be compared to the baseline lead dust concentrations established in these areas (actual number and frequency of lead dust sampling to be determined by SI IH). If baseline levels are exceeded the Contractor shall immediately stop all work except corrective actions. The SI IH and the Contractor Superintendent will determine the source of the lead dust.

3.7 GENERAL PREPARATION OF LEAD WORK AREAS

A. The Contractor shall not handle any exhibit or collection object without the approval of the COTR. The Contractor shall submit proposed methods for surface decontamination and/or disposal of unsalvageable objects to the COTR for approval.

B. The Contractor shall coordinate the sequence of lead work area preparation throughout the building with the COTR and other trades to properly segregate work areas from areas that must remain fully or partially operational or in which other construction is being performed.

C. Doorways and corridors which will not be used for passage during work shall be sealed with 13 mm thick fire retardant plywood, fire retardant wood framing, and poly sheeting with tape.

D. All heating, ventilating, and air conditioning (HVAC) components that are in, supply, or pass through the work area shall be shut down. During the Work, elevators, exhaust fans, and HVAC vents and intakes will be key locked to not operate in the work area. The Contractor shall coordinate with the COTR and the Building Manager which areas are to be shut down and for what duration.

E. The Contractor shall provide temporary power and lighting and ensure safe installation of temporary power sources and equipment in accordance with NFPA electric code requirements. Electrical power equipment shall be properly disconnected, locked out, and tagged so that the equipment can be safely serviced during the Work.

F. The Contractor shall arrange for the lead work area to be locked during non-work hours. Install temporary doors with entrance-type lock sets that are key lockable from the outside and always unlocked and operable from the inside. Remove deadbolts and padlocks. Provide one key (to be held by the Smithsonian Institution Security Office) to the COTR.

G. The Contractor shall supply water to the work area as required.

H. Isolation of the work area for O&M work may be modified, as practical, with approval of the COTR, and in accordance with the "Operations and Maintenance Procedures and Controls" section of this specification.

3.8 PREPARATION OF INTERIOR LEAD WORK AREAS WHERE AIRBORNE LEAD CONCENTRATIONS ARE KNOWN OR EXPECTED TO EXCEED THE OSHA ACTION LEVEL

A. Lead Work Area Preparation:

1. The Contractor shall not handle any exhibit or collection object without the approval of the COTR. Methods for surface decontamination and/or disposal of unsalvageable objects shall be determined by the COTR.
2. The Contractor shall clean and remove items required for access; clean all furniture, equipment, and supplies in the work area with a HEPA-filtered vacuum or by wet wiping, as directed by the COTR, prior to being moved or covered.
3. The Contractor shall clean, by HEPA-filtered vacuum or by wet wiping, and remove all electrical and mechanical items (e.g., lighting fixtures, clocks, diffusers, registers, etc.) and general construction items (e.g., cabinets casework, door and window trim, moldings, etc.) which cover the surface of the Work, as directed by the COTR. Reinstall all such materials upon completion of the Work with materials, finishes, and workmanship to match conditions existing before start of the Work.
4. The Contractor shall remove all removable furniture, equipment, and supplies that have been deemed by the COTR to be uncontaminated or shall completely seal with two layers of 0.15 mm (six-mil) poly sheeting and duct tape. Such sealed furniture, equipment, and supplies shall be considered outside the work area unless the poly seal is breached.
5. The Contractor shall clean all surfaces in the lead work area with a HEPA-filtered vacuum or by wet wiping, as directed by the COTR.
6. The Contractor shall seal all critical barriers, including ventilation openings (supply and exhaust), seams in HVAC system components, lighting fixtures, clocks, doorways, windows, speakers, and other openings into the work area with one layer of 0.15 mm (six-mil) poly sheeting and duct tape. If a temporary poly/ wood stud wall must be erected, it shall be treated as a critical barrier.

7. The Contractor shall seal the front of any existing elevator in the work area with two layers of 0.15 mm (six-mil) poly sheeting and duct tape.
8. The Contractor shall exercise caution when sealing lighting fixtures and control boxes to avoid melting or burning of poly. The insides of lighting fixtures, control boxes, and buss lines shall be cleaned only by lead abatement workers specially certified to work on high voltage lines.
9. The Contractor shall cover the floor of the work area with two layers of 0.15 mm (six-mil) poly sheeting turned up at the walls at least 600 mm. Spray-glue and duct tape all seams in floor poly. Size to minimize number of seams. Locate seams in the top layer 2 meters from, or at right angles to, seams in bottom layer. Install poly so that the top layer can be removed independently of the bottom layer. Do not locate seams at the wall/floor interface.
10. The Contractor shall cover existing carpeting in the work area with three layers of 0.15 mm (six-mil) poly sheeting. Place one layer of 13 mm fire retardant plywood between the top and middle layers of poly.
11. The Contractor shall cover poly in areas where scaffolding is to be used with a single layer of 13 mm fire retardant plywood. Wrap edges and corners of each sheet of plywood with duct tape.
12. The Contractor shall cover all walls in the work area, including sealed critical barriers, with two layers of 0.15 mm (six-mil) poly sheeting, sealed with duct tape or spray-glue. Size to minimize number of seams. Seams shall be staggered and separated by at least 600 mm. Wall poly shall overlap floor poly by at least 400 mm beyond wall/floor interface. Tape all joints, including those joining with the floor covering, with duct tape or as otherwise indicated by the COTR.
13. The Contractor shall not cover or alter automatic sprinkler heads and fire detectors to prevent or delay operation. Smoke detectors shall be protected (but not completely sealed) to avoid nuisance alarms during paint or demolition operations. The smoke detectors shall be cleaned by wet wiping at the end of each work day.
14. The Contractor shall install an additional layer of poly on the floor as a drop cloth to protect the primary floor layers from debris. The drop cloth shall be rolled and disposed of as lead-contaminated waste at the end of each work day and a new drop cloth installed at the beginning of each work day.
15. The Contractor shall provide emergency exiting from the contained lead work area as required by NFPA. Arrange emergency exit doors to be secure from outside the work area but to permit exiting from the work area. Mark outline of door on barriers with luminescent paint at least 150 mm wide. Hang a utility knife on a string beside outline. Post a sign identifying “EMERGENCY EXIT”, using letters at least 150 mm high, inside outline with luminescent paint. Arrows shall be taped on the poly wall at eye level and at floor level to indicate the location of each exit.
16. At the entrance to the lead work area, the Contractor shall post the building floor plan and escape routes, plus the locations of nearest exits and phone numbers of the Smithsonian Institution Security Office.
17. Where not provided by the Smithsonian Institution, the Contractor shall provide emergency lighting in accordance with the Life Safety Code.
18. The Contractor shall install a 4.5 kg ABC type portable fire extinguisher by each emergency exit and in the clean room of the decontamination unit.
19. The Contractor shall install inspection windows in the containment walls. Each window shall have a 600 mm x 600 mm viewing area fabricated from 6 mm clear acrylic or polycarbonate sheeting. Install each window with its top at 2 m above floor height in a manner that provides unobstructed vision from outside to inside of the work area. A sufficient number of windows shall be installed to provide observation of the entire work

area. Provide for viewing to be blocked from the inside with an opaque plastic flap on each window.

20. Where the work area is immediately adjacent to or within view of occupied areas, the Contractor shall provide a visual barrier of opaque 0.15 mm (six-mil) poly so that the work procedures are not visible to building occupants. Where this visual barrier would block natural light, provide substitute barrier as directed by COTR.
21. The Contractor shall provide GFCI protection for all electrical equipment.

B. Construction of Decontamination Unit

1. The Contractor shall construct a three-stage worker/equipment decontamination unit at each location where workers and equipment will enter or exit the work area.
2. Decontamination units shall consist of a Clean Room, a Wash Area (with shower facilities when required by these Specifications), and an Equipment Room, each separated by 1.0 meter air locks (narrower air locks may be built if approved by the COTR).
3. All rooms shall be constructed of 0.15 mm (six-mil) poly sheeting and suitable framing. Seams shall be staggered and separated by at least 150 mm. Spray glue and duct tape all seams.
4. Doorways shall be constructed of three sheets of 0.15 mm (six-mil) poly from ceiling to floor. The width of these poly sheets shall be sufficient to prevent air movement through the doorways when closed. These doorways shall be the only source of make-up air for the air filtration units under normal circumstances, unless other sources are specifically approved by the COTR.
5. The Contractor shall provide temporary lighting inside the decontamination unit.
6. The Contractor shall transport properly containerized lead-containing or contaminated waste through the decontamination unit or through a separate waste load-out unit. If a separate waste load-out unit is used, it shall be built with two airlocks, with curtained doorways; one to the work area and one to an uncontaminated area outside the work area. These doorways shall be sealed except during waste load out activities.
7. Clean Room:
    a. The Contractor shall construct a clean room outside the wash area for the workers to change into protective equipment. The clean room shall have a curtained doorway leading to the outside of the work area, and an airlock leading to the wash area.
    b. The clean room shall be of sufficient size to accommodate at least one worker, a supply of clean disposable coveralls, and storage facilities for street clothing and other uncontaminated equipment.
    c. The Contractor shall not permit lead-contaminated equipment or personnel to enter the clean room. The Contractor shall ensure that employees do not leave the work area wearing protective clothing.
8. Wash Area:
    a. The Contractor shall ensure that employees wash or shower each time when leaving the work area.
    b. The Contractor shall provide shower facilities in the wash area of the decontamination unit when airborne lead concentrations exceed or are expected to exceed 30 □g/m3. The shower facilities shall contain both cold and hot water, soap, and clean towels.
    c. The Contractor shall provide a leak-tight shower unit with an integrated drain pan fabricated from fiberglass or other durable waterproof material; equip with hose bibs for hot and cold water. Arrange water shut off and drain pump operation

controls so that a single individual can shower without assistance from either inside or outside of the work area. Provide splash-proof entrances.

d. The Contractor shall provide back-flow prevention device and vacuum breaker, where required. Filter waste water using filters having a maximum pore size of 5.0 micron, or dispose of water in accordance with these Specifications. Locate filters inside shower unit so that water lost during filter changes is caught by shower pan. Change filters daily or more often if necessary.

e. Where showers are not provided, the Contractor shall provide adequate washing facilities in the wash area of the decontamination unit.

f. Washing facilities shall contain both cold and hot water, soap, and towels.

9. Equipment Room:

a. The equipment room shall have two airlocks, one adjacent to the work area and one adjacent to the wash area.

b. The equipment room shall be of sufficient size to accommodate at least one worker to change clothes, a disposable bag and container for assorted waste, and any lead-contaminated equipment which the Contractor wishes to store when not in use.

c. The equipment room shall contain facilities for decontaminating material and equipment.

C. At the COTR's approval, the Contractor may perform limited lead work activities utilizing a mini containment to isolate the work area. The mini containment shall be equipped with an adjacent wash area and be sealed at all seams to where it is attached to adjacent work surfaces. The mini-containment shall satisfy all requirements for a lead work area as outlined in these Specifications.

D. Creating Negative Pressure in Containment:

1. Negative pressure is required when airborne lead concentrations exceed or are expected to exceed the PEL, 50 □g/m3. The Contractor shall submit a negative exposure assessment and obtain COTR approval when the work will be performed without negative pressure inside the work area.
2. The Contractor shall provide HEPA filters that have been individually tested and certified by the manufacturer to have an efficiency of not less than 99.97 percent when challenged with 0.3 µm di-octyl phthalate (DOP) particles when tested in accordance with Military Standard Number 282 and Army Instruction Manual 136-300-175A. Provide filters that bear a UL586 label to indicate ability to perform under specified conditions.
3. The number of air filtration units needed to achieve the required air circulation rate shall be determined by the following formula:

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CALCULATE	Volume of Work Area (Ft3)
MULTIPLY BY	Number of air changes per hour, minimum of ten-10 (HUD Recommended)
MULTIPLY BY	1/60 (hr/minutes) (0.0167)
DIVIDE BY	80% of capacity of the air filtration units fully loaded with all filters

ADD one additional unit as backup for machine failure or shutdown

EQUALS minimum number of units required (round up to next whole number)

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4. As necessary to achieve air flow throughout the work area, the Contractor shall locate auxiliary makeup air inlets as far away as possible from the air filtration units, preferably near the ceiling and away from barriers that separate the containment from surrounding areas. Cover inlet with poly sheeting flaps to reseal automatically if the pressure differential system should shut down for any reason. Provide rigid framing around the opening. Spray flap and around opening with spray adhesive so that if flap closes meeting surfaces are both covered with adhesive. Use an adhesive that forms contact bond when dry.

E. Placement of Air Filtration Units:

1. The Contractor shall locate air filtration units to optimize air movement throughout the work area. Position air filtration units opposite the decontamination unit or other make-up air inlets.
2. The backup air filtration unit shall be located on site and be available and ready to run at any time.
3. The Contractor shall establish air movement so that airborne lead dust will be carried away from workers' breathing zones.
4. Dead-air pockets shall be minimized by proper ducting of make-up air, if necessary, and by optimum location of the air filtration units. The Contractor shall use smoke tubes to determine if dead-air pockets are present and shall take corrective action as outlined above when they are found. Report such corrective actions to the COTR immediately.
5. The Contractor shall locate the air filtration units such that access for changing the pre-filters is from inside the containment. The units shall run continuously during pre-filter changing. A supply of filters shall be kept on site outside of containment. If a unit must be turned off for servicing, a backup unit shall be installed.
6. Mount units to exhaust directly or through disposable ductwork outside the building. Use ductwork and fittings of same diameter or larger than discharge connection on fan unit. Use spiral wire-reinforced flex duct in lengths not greater than 15 meters. If direction of discharge from fan unit is not aligned with duct, use sheet metal elbow to change direction. Use 2 meters of spiral wire reinforced flex duct after each direction change.
7. Units may be vented inside the building, as directed by the COTR, only if outside venting is impractical. Units venting inside a building must be vented through an expansion chamber or diffuser system (self-contained water baffle) to reduce the exhaust air velocity. Exhaust ductwork shall be placed as far away as possible from occupied areas.

F. Use of System During the Work:

1. The Contractor shall start air filtration units before beginning abatement work. After work has begun, run units continuously to maintain a constant pressure differential and air circulation until decontamination of the work area is complete and final clearance results have been accepted by the COTR. Do not turn off units at the end of the work shift or when work temporarily stops unless authorized by COTR.

2. The Contractor shall begin work at a location farthest from the air filtration units and proceed toward them. If an electric power failure occurs, immediately stop all work and do not resume until power is restored and air filtration units are operating again.

3.9 PREPARATION OF EXTERIOR LEAD WORK AREAS WHERE AIRBORNE LEAD CONCENTRATIONS ARE KNOWN OR ARE EXPECTED TO EXCEED THE OSHA ACTION LEVEL

A. Exterior lead work shall not be conducted if wind speeds or gusts are equal to or greater than 30 km/hr; work must stop and cleanup shall be completed before precipitation begins.

B. Exterior Lead Work Area Preparation:

1. The Contractor shall not handle any exhibit or collection object without the approval of the COTR. Methods for surface decontamination and/or disposal of unsalvageable objects shall be determined by the COTR.
2. The Contractor shall erect temporary fencing or yellow or red barrier tape at a minimum of 5 meters from the perimeter of the work area. Fencing and tape shall be a minimum height of 1.5 meters.
3. The Contractor shall post warning signs on the building exterior and along temporary fencing or tape barrier.
4. The Contractor shall clean all furniture, equipment, and supplies in the work area with a HEPA-filtered vacuum or by wet wiping, as directed by the COTR.
5. The Contractor shall clean, by HEPA-filtered vacuum or by wet wiping, and remove all electrical and mechanical items (e.g., lighting fixtures, air conditioners, etc.) and general construction items (e.g., door and window trim, moldings, etc.) which cover the surface of the Work, as directed by the COTR. Reinstall all such materials upon completion of the Work with materials, finishes, and workmanship to match conditions existing before the start of work.
6. The Contractor shall remove, to a 5-meter distance from the work area, all removable furniture, equipment, and supplies that have been deemed by the COTR to be uncontaminated, or completely cover with two layers of 0.15 mm (six-mil) poly sheeting and duct tape. Such furniture, equipment, and supplies shall be considered outside the work area unless the poly seal is breached.
7. The Contractor shall clean all surfaces in the work area with a HEPA-filtered vacuum or by wet wiping, as directed by the COTR.
8. The Contractor shall install a minimum of two layers of 0.15 mm (six-mil) poly sheeting on all critical barriers in the work area to the building interior (e.g., windows, doors, air intake grills, window air conditioning units, etc.).
9. The Contractor shall cover the floor surface of the work area with two layers of 0.15 mm (six-mil) poly sheeting, turned up at any walls at least 600 mm. Spray glue and duct tape all seams in the floor sheeting; size sheets to minimize number of seams. Locate seams in top layer 2 meters from, or at right angles to, seams in bottom layer. Install poly so that top layer can be removed independently of bottom layer. Do not locate seams at wall/floor interfaces.
10. Do not anchor ladder feet on top of poly; the poly shall be punctured to provide secure anchoring of the footings to the surface underneath. Punctures in the poly shall be resealed with a minimum of two layers of poly sheeting.

11. The Contractor shall cover poly sheeting in areas where scaffolding is to be used with a single layer of 13 mm thick fire retardant plywood. Wrap edges and corners of each plywood sheet with duct tape.
12. The Contractor shall install an additional layer of poly on the ground as a drop cloth to protect the primary floor layers from debris. The drop cloth shall be rolled and disposed as contaminated waste at the end of each work day and a new drop cloth installed at the beginning of each work day.
13. Where applicable, or as directed by COTR, the Contractor shall protect work area surfaces with 13 mm thick fire retardant plywood or appropriate substitute to protect against falling debris (e.g., nails, tools, etc.).
14. The Contractor shall install a minimum of two layers of 0.15 mm (six-mil) poly sheeting 5 meters in width around the perimeter of the work area. The sheeting shall be sufficiently weighted at all edges to prevent migration of the sheeting. The sheeting shall be placed in a manner that traps all debris and water; this is best accomplished by elevating the edges.
15. The Contractor shall install a 4.5 kg ABC type portable fire extinguisher in the clean area adjacent to the decontamination unit.
16. The Contractor shall provide GFCI protection for all electrical equipment; provide temporary lighting in the work area.

C. Construction of Decontamination Unit:

1. The Contractor shall construct a decontamination unit at each location where workers and equipment will enter or exit the work area.
2. The decontamination unit shall be directly adjacent to the work area and shall consist of an equipment room and wash area in series. The Contractor shall ensure that employees use the decontamination unit prior to leaving the work area.
3. The Contractor shall select and designate a clean area adjacent to the entrance to the wash area for the workers to change into protective equipment. The clean area shall contain clean clothes and towels, and storage area for HEPA vacuums, respirators, and other personal protective equipment.
4. Contaminated equipment or personnel shall not be permitted in the clean area. The Contractor shall ensure that employees do not leave the work area wearing protective clothing. Post OSHA decontamination procedures in the clean area for duration of the Work.
5. The Contractor shall provide shower facilities in the wash area of the decontamination unit when airborne lead concentrations exceed or are expected to exceed 30 □g/m3. The shower facilities shall contain both cold and hot water, soap, and towels.
6. The Contractor shall provide a leak-tight shower unit with an integrated drain pan fabricated from fiberglass or other durable waterproof material; equip with hose bibs for hot and cold water. Arrange water shut off and drain pump operation controls so that a single individual can shower without assistance from either inside or outside of the work area. Provide splash-proof entrances.
7. The Contractor shall provide back-flow prevention device and vacuum breaker, where required. Filter waste water using filters having a maximum pore size of 5.0 microns, or dispose of water in accordance with these Specifications. Locate filters inside shower unit so that water lost during filter changes is caught by shower pan. Change filters daily or more often if necessary.
8. Where showers are not provided, the Contractor shall provide adequate washing facilities in the wash area of the decontamination unit.
9. Washing facilities shall contain both cold and hot water, soap, and towels.

10. The Contractor shall filter waste water using filters having a maximum pore size of 5.0 microns, or dispose of water as lead-contaminated waste in accordance with these Specifications.

3.10 PREPARATION OF LEAD WORK AREAS WHERE THE AIRBORNE LEAD CONCENTRATIONS ARE BELOW OR EXPECTED TO BE BELOW THE ACTION LEVEL

A. The following procedures define the requirements for the preparation of an interior lead work area where work activities generate or are expected to generate concentrations of airborne lead less than the OSHA Action Level.

1. The Contractor shall not handle any exhibit or collection object without the approval of the COTR. Methods for surface decontamination and/or disposal of unsalvageable objects shall be determined with input from the COTR, the object owner, the Contractor, and the SI IH.
2. The Contractor shall clean all furniture, equipment, and supplies in the work area with a HEPA-filtered vacuum or by wet wiping, as directed by the COTR, prior to being moved or covered.
3. The Contractor shall clean, by HEPA-filtered vacuum or by wet wiping, and remove all electrical and mechanical items (e.g., lighting fixtures, clocks, diffusers, registers, etc.) and general construction items (e.g., cabinets, casework, door and window trim, moldings, etc.) which cover the surface of the Work, as directed by the COTR. Reinstall all such materials upon completion of the Work with materials, finishes, and workmanship to match conditions existing before start of the Work.
4. The Contractor shall remove all removable furniture, equipment, and supplies that have been deemed to be uncontaminated by the COTR, or with the approval of the COTR shall completely seal with two layers of 0.15 mm (six-mil) poly sheeting and duct tape. Such furniture, equipment, and supplies shall be considered outside the work area unless covering poly seal is breached.
5. The Contractor shall install an air lock at each doorway entrance to the work area. Air locks shall be constructed using two sheets of 0.15 mm (six-mil) poly sheeting. The first layer shall be sealed at the top, the floor, and each side of the doorway; cut a slit for passage down the middle of the first layer; do not cut the slit all the way to the floor. Tape the second sheet of plastic across the top of the door only, so that it acts as a flap. The flap shall open into the work area. Post lead warning signs at each doorway entry to the work area.
6. The Contractor shall seal all ventilation openings (supply and exhaust), and seams in HVAC system components with two layers of 0.15 mm (six-mil) poly sheeting.
7. The Contractor shall clean all surfaces in the work area with a HEPA-filtered vacuum or by wet wiping, as directed by the COTR.
8. The Contractor shall cover the floor of the work area with two layers of 0.15 mm (six-mil) poly sheeting as a drop cloth.
9. The Contractor shall install a 4.5 kg ABC type portable fire extinguisher at the entrance to the work area.
10. The Contractor shall provide GFCI protection for all electrical equipment.
11. The Contractor shall designate a decontamination area at the entrance to the work area and shall provide washing facilities that include both cold and hot water, soap, and a sufficient quantity of clean towels.

12. The Contractor shall filter waste water using filters having a maximum pore size of 5.0 microns, or dispose of water in accordance with these Specifications.

B. The following procedures define the requirements for the preparation of an exterior lead work area where work activities generate or are expected to generate concentrations of airborne lead less than the OSHA Action Level.

1. The Contractor shall not handle any exhibit or collection object without the approval of the COTR. Methods for surface decontamination and/or disposal of unsalvageable objects shall be determined by the COTR.
2. Exterior lead-based paint interim control work shall not be conducted if wind speeds or gusts are equal to or greater than 30 km/hr; work must stop and cleanup shall be completed before precipitation begins; work shall not begin if precipitation has been forecast to occur during the work shift.
3. The Contractor shall erect temporary fencing, or yellow or red barrier tape, at a minimum of 5 meters from the perimeter of the work area. Fencing and tape should be a minimum height of 1.5 meters.
4. The Contractor shall post warning signs on the building exterior and along the temporary fencing or tape barrier.
5. The Contractor shall clean all furniture, equipment, and supplies in the work area with a HEPA-filtered vacuum or by wet wiping, as directed by the COTR.
6. Remove to a 5-meter distance from the work area all removable furniture, equipment, and supplies that have been deemed by the COTR to be uncontaminated, or with the approval of the COTR completely cover with two layers of 0.15 mm (six-mil) poly sheeting and duct tape. Such furniture, equipment, and supplies shall be considered outside the work area unless the poly seal is breached.
7. The Contractor shall seal all ventilation openings with two layers of 0.15 mm (six-mil) poly sheeting.
8. The Contractor shall clean, by HEPA-filtered vacuum or by wet wiping, and remove all electrical and mechanical items (e.g., lighting fixtures, air conditioners, etc.) and general construction items (e.g., door and window trim, moldings, etc.) which cover the surface of the Work, as directed by the COTR. Reinstall all such materials upon completion of the Work with materials, finishes, and workmanship to match conditions existing before the start of work.
9. The Contractor shall clean all surfaces in the work area with a HEPA-filtered vacuum or by wet wiping, as directed by the COTR.
10. The Contractor shall cover the floor of the work area with two layers of 0.15 mm (six-mil) poly sheeting. An additional layer of poly sheeting shall be installed as a drop cloth. Extend poly floor layers to a 5-meter distance around the perimeter of the work area. The sheeting shall be sufficiently weighted at all edges to prevent migration of the sheeting. The sheeting shall be placed in a manner that traps all debris and water; this is best accomplished by elevating the edges.
11. The Contractor shall not place ladder footings directly on the top layer of floor poly. Rather, the poly shall be punctured to provide secure anchoring of the footings to the surface underneath. Punctures in the poly shall be resealed with two layers of 0.15 mm (six-mil) poly sheeting.
12. The Contractor shall designate a decontamination area at the entrance to the work area and shall provide washing facilities that include both cold and hot water, soap, and a sufficient quantity of clean towels.
13. The Contractor shall filter waste water using filters having a maximum pore size of 5.0 microns, or dispose of water in accordance with these Specifications.

14. The Contractor shall install a 4.5 kg ABC type portable fire extinguisher at the entrance to the work area.
15. The Contractor shall provide GFCI protection for all electrical equipment.

3.11 PRE-INSPECTION OF LEAD WORK AREAS

A. The Contractor shall perform the following actions for the SI IH and the COTR prior to beginning the work. These actions may be modified for pre-inspection of O&M work areas, per the "Operation and Maintenance Procedures and Controls" of this specification.

1. Show proper sealing of poly layers, including all critical barriers.
2. Use smoke tubes to demonstrate that air is not escaping the work area; use smoke tubes to demonstrate that the shaft of each elevator in the work area is a positively pressurized space relative to the containment.
3. Demonstrate procedures for how workers will enter and exit the decontamination unit.
4. Demonstrate procedures for handling emergencies and for the prevention of contamination of surrounding areas.
5. With the COTR, identify disabled elevators and building ventilation systems and the means that will prevent accidental or premature restarting. Confirm means to have units restarted at the conclusion of the Work. With the COTR, verify that all affected equipment is secured at the main breaker.
6. Demonstrate how lead-contaminated wash water will be filtered and drained, or collected for disposal.
7. Demonstrate how lead-containing and lead-contaminated waste will be removed for transport, where the waste will be stored, and how it will be secured during storage; identify procedures for hauling waste through the building to the loading area.

B. The Contractor shall perform the following additional actions for the COTR prior to beginning all work using negative pressure in the work area:

1. Demonstrate that the work area can maintain negative pressure of 0.5 mm of water for a minimum of 2 hours prior to commencement of the Work, unless the system is exhausted through an isolated ventilation system. In this case, the test period shall be long enough to ensure that the lock-out ventilation controls are not over ridden and the HVAC system does not reactivate. At a minimum, the Contractor shall make all arrangements and demonstrate satisfactory equipment operation and set-up for compliance with these Specifications.
2. Show proper condition of equipment seals.
3. Show proper operation of safety and warning devices.
4. Show proper operation and calibration of instrumentation.
5. Show identification of air filtration units and each unit's capacity.
6. Use smoke tubes to demonstrate that negative air pressure and adequate air circulation is being maintained in the work area and that no dead air pockets are present in the work area. Demonstrate positive air motion through the decontamination unit into the work area.
7. Show the installation method for pre-filters, and the HEPA primary filter in the air filtration unit. Show supply of filters available on site.
8. Use a pressure differential meter or manometer to demonstrate the required pressure differential at every barrier separating the work area from the balance of the building, equipment, ductwork, or outside.

9. Demonstrate that each air filtration unit is serviced by a minimum 115V-20A circuit with GFCI protection.

C. The Contractor shall begin the lead work activities only after the following criteria have been met:

1. Pre-abatement testing has been conducted.
2. The work area has been prepared according to these Specifications.
3. The prepared work area has been inspected and approved by the COTR.
4. Arrangements have been made for managing and disposing of the waste at an acceptable site.

3.12 MAINTENANCE OF LEAD WORK AREAS

A. The Contractor shall ensure that the work area isolation methods are effectively sealed and taped for the duration of the Work.

B. The Contractor shall repair damaged lead work areas and remedy defects immediately upon discovery. Visually inspect each lead work area containment at the beginning, middle, and end of each work shift. Use smoke tubes to test the effectiveness of the containment on a daily basis and when requested by the COTR or SI IH.

C. Damaged or deteriorating materials shall not be used and shall be removed from the premises. Material that becomes exposed to and contaminated with lead shall be decontaminated or disposed of as lead-contaminated waste in accordance with the procedures outlined in these Specifications.

D. The Contractor shall clean debris and residue inside of the decontamination unit on a daily basis. Clean debris from shower pans on a daily basis.

E. The Contractor shall maintain dry floors in the clean room and airlocks to minimize slips and trips.

F. The Contractor shall maintain emergency and fire exits from the work area, or establish alternative exits satisfactory to the COTR. Maintain appropriate fire extinguishers in all work areas for the duration of the Work.

3.13 PROHIBITED LEAD WORK METHODS

A. Open Flame Burning or Torching, unless appropriate engineering controls as well as PPE are utilized in accordance with 29 CFR 1926.353 and 354 and approved by SI-OSHEM:

1. Burning, torching, fossil fuel-powered heat plates, welding, and cutting torches are prohibited because of the high temperatures generated in the process; at these temperatures, lead fumes may be produced.
2. Using cutting torches to remove fire escapes, railings, or other metal components coated with lead-paint is prohibited unless the lead-paint is removed first, in accordance with these Specifications.
3. Welding of painted metal components (e.g., pre-primed structural steel) is prohibited by OSHA regulations.

B. Heat Guns Operating Above 590 □C (1,100 ºF):

1. Electric heat guns operating at temperatures greater than 590 □C and 1,100º F are prohibited because of the high temperatures generated in the process; at these temperatures, lead fumes may be produced.

C. Machine Sanding or Grinding Without a HEPA Exhaust Tool:

1. Machine sanding or grinding is prohibited (regardless of the grit used) because of the large volume of leaded dust generated.
2. Extensive dry hand sanding is not permitted, but limited dry sanding or scraping near electrical circuits may be permitted when directed by the COTR.

D. Uncontained Hydroblasting or High-Pressure Water Wash:

1. Uncontained hydroblasting and high-pressure water washing are prohibited due to the large quantity of uncontained lead-contaminated waste water generated.

E. Abrasive Blasting or Sandblasting:

1. Traditional abrasive blasting or sandblasting is prohibited due to the large quantity of lead dust produced.

F. Chemical Paint Removal Using Methylene Chloride-Based Paint Strippers:

1. Chemical paint removers containing methylene chloride are prohibited due to the potential health effects caused by the use of methylene chloride.

G. Dry Scraping:

1. Dry scraping is not permitted because of the large volume of leaded particulate matter generated. However, The COTR may authorize the use of dry scraping in limited surface areas around electrical outlets, where appropriate.
2. Dry scraping is permitted when performed in conjunction with heat gun removal as discussed in Section 3.14.5.B of these Specifications.

3.14 ENGINEERING CONTROLS AND WORK PRACTICES FOR SPECIFIC WORK ACTIVITIES IMPACTING LEAD

3.14.1 Interior Selective Demolition and Whole Component Removal Work Activities

A. Contractor shall prepare work areas where demolition and/or whole building component removal work activities are occurring as work areas exceeding the OSHA Action Level unless the Contractor can provide a NEA for the specific work activity demonstrating that the documented engineering controls and work practices are effective in controlling airborne lead concentrations below the OSHA Action Level as specified in these Specifications.

B. Interior Selective Demolition and Whole Component Work Practices

1. Surfaces to be demolished and/or removed shall be misted with water prior to impacting them.
2. Building components shall be demolished and/or removed in a manner as to minimize the generation of dust within the work area.
3. The work area shall be misted with water as necessary to keep airborne dust levels to a minimum.
4. Using a utility knife or other sharp instrument, the Contractor shall carefully score all affected painted seams. This will provide space for a pry instrument to remove the component and will minimize paint chipping and dust generation during removal.
5. The Contractor shall carefully remove loose and flaking paint by wet scraping or wet sanding, as directed by the COTR. HEPA vacuum and wet wipe the surface.
6. The Contractor shall remove any screws or other fasteners. Using a flat pry instrument and a hammer, carefully pry the selected building component away from the surface to which it is attached. The pry bar shall be inserted into the seam at the nail (or other fastening device) at one end of the component and pressure applied to the pry bar. This process shall be repeated at other fastening locations until the end of the component is reached. By prying in this manner, the component will be removed intact and paint chip and dust generation will be minimized. A pry point pad or softener may be required to minimize damage to adjoining substrates.
7. The Contractor shall carefully remove, or bend back, all nails (or other fastening devices) and place the component in an impermeable waste disposal container, as defined in these Specifications.
8. The Contractor shall deliver the properly sealed component to an off-site paint stripping facility, as directed by the COTR, or dispose of in accordance with these Specifications.
9. Stripped component, or new lead-free component shall not be installed until the work area has been cleaned in accordance with these Specifications, the area has been visually inspected by the SI IH and approved by the COTR, and clearance sampling results have been accepted by the COTR.
10. When lead-free building components are being installed, the lead-free components shall be back caulked prior to installation (back caulk means to apply caulk to underside of the components).
11. Prior to the end of each work shift, the Contractor shall clean the work area floors using wet sweeping/mopping techniques. If a vacuum is to be utilized, it shall be equipped and exhausted through a HEPA filter.
12. Prior to reoccupancy by trade workers or personnel without a minimum of lead awareness training, the work area shall be cleaned and properly cleared for reoccupancy based upon final clearance testing as specified herein.

3.14.2 Interim Controls and Surface Stabilization of Lead-Containing Surfaces for New Finishes

A. Contractor shall prepare work areas where interim controls and surface stabilization work activities are occurring as work areas exceeding the OSHA Action Level unless the Contractor can provide a NEA for the specific work activity demonstrating that the documented engineering controls and work practices are effective in controlling airborne lead concentrations below the OSHA Action Level as specified in these Specifications.

B. Surface Stabilization Work Practices.

1. General Requirements:
    a. All loose surface material should be removed by hand treatments (i.e., wet scraping and wet sanding).
    b. Surface contaminants that prevent adhesion of new finishes should be eliminated by cleaning (i.e., chemical degreasing, trisodium phosphate washing, or other equivalent detergent followed by thorough rinsing).
    c. Surface gloss should be eliminated by chemical etching or wet sanding. All solvents and/or chemicals used on-site are to be pre-approved by the COTR prior to being brought to project site.
    d. Adhesion of new finishes to the substrates may be enhanced by chemical etching, spot sealing, and/or wet sanding.
2. Surfaces shall be misted with water prior to scraping or conduct wet scraping techniques.
3. Wet Scraping:
    a. Wet scraping of lead-containing material shall be conducted to remove loose or flaking paint prior to repainting, encapsulation, or enclosure of the lead-containing material. Wet scraping shall not be employed as an abatement technique over a large surface area without approval from the COTR.
    b. Working one square meter at a time, the Contractor shall lightly mist the surface with amended water using an airless sprayer or hand-held spray bottle. Using a paint scraper, loose lead-containing material shall be scraped from the surface. The Contractor shall use extreme caution not to damage the existing substrate or the integrity of intact lead-containing surface coatings.
    c. Scraper blades shall be kept sharp to minimize surface abrasion and gouging of the substrate. The Contractor shall have sufficient additional blades on site; scraper blades shall be selected for the surface being abated.
    d. To obtain a smooth finish, the Contractor may need to follow wet scraping activities by wet sanding or HEPA-sanding the surface following procedure outlined in these Specifications, as directed by the COTR.
4. Wet Sanding:
    a. Wet sanding shall be employed to remove loose or flaking lead-containing materials prior to repainting, encapsulation, or enclosure of the lead-containing material. Wet sanding shall not be conducted as an abatement technique over a large surface area without approval from the COTR.
    b. Working one square meter at a time, the Contractor shall lightly mist the surface with amended water using an airless sprayer or hand-held spray bottle. Loose lead-containing material shall then be sanded from the surface. The Contractor shall exercise extreme caution not to damage the substrate or the integrity of intact lead-containing surface coatings.
    c. The Contractor shall maintain a slightly wet substrate surface during all wet sanding.

C. Paint film stabilization involves the priming and repainting of lead-containing surface coatings and typically includes performing corrective work or repairs to the building which caused the existing lead-containing surface coating to fail (e.g., moisture problems, mechanically damaged paint, chemical incompatibility, poor surface preparation, aging paint, etc.). These repairs and defects must be specifically addressed prior to paint stabilization.

D. The Contractor shall perform paint film stabilization as an interim lead-control according to the following general guidelines, and as directed by the COTR:

1. Perform all corrective work or repairs to the building which caused the existing lead-containing surface coating to fail. Repair all rotted structural, siding, or railing components; defective plaster; missing door hardware; loose siding or trim; loose wallpaper; etc., as directed by COTR.
2. Prepare the surface by wet scraping or wet sanding, following the procedures in these Specifications, to remove loose, flaking, and deteriorated paint.
3. HEPA vacuum and wet wipe all work area surfaces to remove the paint chips, debris, and dust generated during the Work.
4. Clean, de-gloss, neutralize, and rinse surfaces. Surfaces must be dry before priming or repainting. HEPA vacuum surface after drying.
5. Select primer and topcoat by considering longevity, moisture resistance, and organic compound content with low volatility. Paint film stabilization involves the application of at least two coats (the primer and the topcoat); use a primer/topcoat system from the same manufacturer to ensure compatibility.
6. Apply all paints at thickness according to manufacturer's directions. Apply paint only during proper temperature, wind, and humidity conditions, according to the manufacturer's directions. Allow sufficient time for each coat to dry fully.
7. The COTR will conduct regular evaluations of the stabilized area and report defects or deterioration to the Contractor for re-stabilization.

E. Friction and Impact Surface Treatment of Lead-Containing Surface Coatings

1. Friction surfaces are those surfaces painted with lead-containing material that are subject to abrasion (e.g., window components, tight-fitting doors, cabinet doors, stairway treads and railings, etc.), resulting in the generation of lead-contaminated dust; impact surfaces are protruding surfaces that tend to be bumped or banged (e.g., doors and doorjambs, wall corners, chair rails, baseboards, etc.), causing small chips of lead-containing material to dislodge and fall to the floor.
2. For windows, remove stop bead and parting strip and dispose of properly. Wet scrape deteriorated lead-containing material in accordance with these Specifications. If the window trough is badly weathered, cap with back-caulked, aluminum coil stock. If necessary, repair the window weight and pulley system, as directed by the COTR. Install new window channel or slide system and replace stop bead (and parting strip if required).
3. For doors, remove the doorstop and dispose of properly. Remove door by pulling out hinge pins. Mist and plane door to eliminate friction points. Reinstall door and install new doorstop.
4. For stairs, install a hard, cleanable covering on treads (e.g., rubber tread guards). Carpeting may be used instead, but it must be securely fastened so that it does not cause abrasion. Stabilize paint on banisters, balusters, and newel posts.
5. For baseboards, remove and dispose of shoe molding and replace, as directed by the COTR.

6. For abraded outside wall corners, install new plastic or wood corner protector, as directed by the COTR.
7. Perform the removal of lead-contaminated dust, as directed by the COTR, in accordance with these Specifications.
8. Prior to reoccupancy by trade workers or personnel without a minimum of lead awareness training, the work area shall be cleaned and properly cleared for reoccupancy based upon final clearance testing as specified herein.

3.14.3 Stripping of Lead-Containing Surface Coatings with a Chemical Solvent

A. Contractor shall prepare work areas where stripping LCM using chemical solvents is occurring as work areas exceeding the OSHA Action Level unless the Contractor can provide a NEA for the specific work activity demonstrating that the documented engineering controls and work practices are effective in controlling airborne lead concentrations below the OSHA Action Level as specified in these Specifications.

B. Chemical stripping agents shall contain no methylene chloride products. Chemical stripping agents shall be compatible with, and not harmful to the substrate to which they are applied. The Contractor shall comply with the manufacturer's recommendations for use of the stripping agent.

C. The Contractor shall carefully consult the MSDS for the stripping agent selected to determine potential chemical hazards and appropriate personal protective equipment. The Contractor shall provide sufficient quantities of personal protective equipment, as required by OSHA and in accordance with the manufacturer's Specifications, when performing chemical stripping. The following personal protective equipment shall be supplied, at a minimum:

1. chemically resistant clothing
2. long neoprene, rubber, or PVC gloves
3. face shields
4. eyewash station with an abundant source of water
5. an abundant source of running water to flush chemicals from the skin
6. proper secondary chemical respiratory filters, in addition to those for lead dust

D. The Contractor shall apply the chemical stripping agent to the building component surface to be abated. The stripping agent shall be applied with a spatula, trowel, brush, or spray gun, in accordance with the manufacturer's Specifications. Spray gun use is permitted only with prior approval of the COTR. The Contractor shall exercise extreme caution when applying the stripping agent to overhead surfaces to avoid dripping onto workers below.

E. The Contractor shall allow the stripping agent to remain on the lead-containing surface coating for the manufacturer's recommended time period. The stripping agent shall not be allowed to dry out, and shall be covered with a poly or paper blanket that is pressed to the surface to prevent drying.

F. The Contractor shall manually remove the treated paint from the substrate using a scraper or a putty knife. The Contractor shall exercise extreme care not to damage the substrate.

G. Scraper blades shall be kept sharp to minimize surface abrasion and gouging of the substrate. The Contractor shall have sufficient additional blades on site; scraper blades shall be selected for the surface being abated.

H. The Contractor shall thoroughly scrub the surface with a solution of glacial acetic acid to neutralize the abated substrate and remove residual residue (wood surfaces shall not be permitted to dry). The use of vinegar as a neutralization agent is prohibited. The Contractor shall carefully consult the MSDS for the neutralization agent and shall provide personal protective equipment accordingly to the abatement workers.

I. Following neutralization, the damp surface shall be thoroughly scrubbed with a high-phosphate detergent or other acceptable cleaner. Scrubbing should continue until no visible residues remain. The cleaning solution must be changed regularly.

J. The Contractor shall scrub the surface with clean water to remove residue. The pH of the water wash shall be checked after use. If the pH of the water wash exceeds 8.0, further neutralization of the surface with the acetic acid solution is necessary; an alkaline surface (pH of 8.0 or greater) may not be compatible with new paint.

K. For wood surfaces, if the moisture has raised the grain and sanding of the wood surface is required before repainting, a HEPA-equipped sander shall be used in accordance with these Specifications.

L. Prior to reoccupancy by trade workers or personnel without a minimum of lead awareness training, the work area shall be cleaned and properly cleared for reoccupancy based upon final clearance testing as specified herein.

3.14.4 Installation of Enclosure Systems for Lead-Containing Surfacing Coatings

A. Contractor shall prepare work areas where enclosure systems are installed as work areas exceeding the OSHA Action Level unless the Contractor can provide a NEA for the specific work activity demonstrating that the documented engineering controls and work practices are effective in controlling airborne lead concentrations below the OSHA Action Level as specified in these Specifications.

B. All soft, moveable, or otherwise structurally unsound structural members required to support the enclosure shall be repaired prior to enclosure. If repair is not feasible, enclosure will not be possible and an alternative abatement method shall be selected, as directed by the COTR.

C. Prior to enclosure, the Contractor shall label the lead-containing surface to be enclosed, approximately every 1.0 meter, horizontally and vertically, with a warning: "Danger: Lead-Containing Surface Coatings". The stamp lettering should be done in permanent ink.

D. When enclosing lead-containing floors, the Contractor shall remove all dirt and debris with a HEPA vacuum prior to installing the enclosure to avoid lumps in the new flooring.

E. When installing enclosures directly to a lead-containing surface, the Contractor shall use both an adhesive and mechanical fasteners (e.g., nails, screws, etc.) to anchor the enclosure.

F. The following are acceptable enclosure materials and general procedures for installing these materials. Actual enclosure material selected to be authorized by the COTR (additional materials not listed here may be acceptable; the Contractor shall coordinate with the COTR for use of materials and procedures not provided in these Specifications):

1. Wood Paneling:
   a. Prior to installation of enclosure, the Contractor shall carefully remove flaking and loose areas of lead-containing material by wet scraping or wet sanding, as directed by the COTR. Allow intact paint with good adhesion to remain
   b. The Contractor shall caulk all seams in the lead-containing painted component to be enclosed.
   c. The Contractor shall anchor wood paneling to the substrate with both adhesive and mechanical fastener, as directed by COTR.
   d. The Contractor shall scribe and cut the enclosure woodwork to fit adjoining existing work and shall refinish cut surfaces or repair damaged finish at cuts.
   e. Wood paneling is not permitted as a ceiling enclosure.
2. Laminated Products:
   a. Prior to installation of enclosure, the Contractor shall carefully remove areas of flaking and loose lead-paint by wet scraping or wet sanding, as directed by the COTR. Allow intact paint with good adhesion to remain.
   b. Laminated products shall be anchored directly to the lead-containing surface coatings substrate.
3. Ridged Tile and Brick Veneers:
   a. Prior to installation of enclosure, the Contractor shall carefully remove areas of flaking and loose lead-containing material by wet scraping or wet sanding, as directed by the COTR. Allow intact paint with good adhesion to remain.
   b. Rigid tile and brick veneers shall be glued or cemented directly to the lead-containing material.
4. Drywall and Fiberboard:
   a. Prior to installation of enclosure, the Contractor shall carefully remove areas of flaking and loose lead-containing material by wet scraping or wet sanding, as directed by the COTR. Allow intact paint with good adhesion to remain.
   b. The Contractor shall remove any trim to be disposed of and install the drywall and fiberboard over any cavity left by the removed trim, except large cavities over 400 mm in any direction. Repair any structural deficiencies, as directed by the COTR.
   c. The Contractor shall use construction adhesive to glue the drywall and fiberboard directly to the lead-containing material being enclosed.

d. The Contractor shall screw the drywall and fiberboard to the studs behind the existing wall. Caulk all seams that meet molding.
e. The Contractor shall use extension rings to bring out electrical devices flush with the new drywall and fiberboard and retrofit any HVAC registers. Caulk all seams.
f. The Contractor shall tape and finish the drywall.

5. Sheet Metal:
   a. Prior to installation of enclosure, the Contractor shall carefully remove areas of flaking and loose lead-containing material by wet scraping or wet sanding, as directed by the COTR. Allow intact paint with good adhesion to remain.
   b. The Contractor shall locate and place sheet metal fabrications plumb, level, and in alignment with adjacent existing building construction.
   c. The Contractor shall back caulk at the perimeter of the sheet metal enclosure, sealing seams to form a continuously sealed enclosure
6. Siding:
   a. Siding may be used to enclose exterior lead-containing surface coatings prior to installation of enclosure. Prior to installation, the Contractor shall carefully remove areas of flaking and loose lead-containing material by wet scraping or wet sanding, as directed by the COTR. Allow intact paint with good adhesion to remain.
   b. The Contractor shall comply with the siding manufacturer's installation instructions and recommendations. Install rigid sheathing or furring strips to provide a level surface prior to the installation of siding. Do not remove the existing lead-painted siding.
   c. The Contractor shall install siding and accessories to cover all lead-containing surface coatings. Field fabricated accessories that are not commercially available from sheet aluminum stock or wood. All seams shall be caulked and back-caulked.
7. Windows:
   a. Prior to installation of enclosure, the Contractor shall carefully remove areas of flaking and loose lead-containing material by wet scraping or wet sanding, as directed by the COTR. Allow intact paint with good adhesion to remain.
   b. Snap-in replaceable aluminum and vinyl window tracks shall be pressed into a bead of caulk at each joint.
   c. Window troughs shall be covered with fitted metal and screwed into place. The metal shall be pressed into a bead of caulk at the joints and edges.

G. Following the installation of the enclosure material, the Contractor shall install extension rings for all electrical switches and outlets that will penetrate the enclosure.

H. The Contractor shall seal and back-caulk all seams and joints.

I. The COTR will evaluate the integrity of the enclosure system on a regular basis and following any significant damage due to plumbing or roof leaks, tornadoes, hurricanes, floods, earthquakes, etc. The Contractor shall immediately perform repairs to the damaged areas, as directed by the COTR.

J. Prior to reoccupancy by trade workers or personnel without a minimum of lead awareness training, the work area shall be cleaned and properly cleared for reoccupancy based upon final clearance testing as specified herein.

3.14.5 Mechanical Methods of Lead-Containing Surface Coatings Removal

A. Contractor shall prepare work areas where LBP and/or LCM are removed as work areas exceeding the OSHA Action Level unless the Contractor can provide a NEA for the specific work activity demonstrating that the documented engineering controls and work practices are effective in controlling airborne lead concentrations below the OSHA Action Level as specified in these Specifications.

B. Heat Guns:

1. The Contractor shall use heat guns operating below 590 □C (1100□ F) only; the use of heat guns operating at temperatures greater than 590 □C (1100□ F) is prohibited.
2. Heat gun removal may only be conducted in negative pressure containments, constructed in accordance with these Specifications.
3. The Contractor shall exercise extreme caution when performing heat gun removal around wallpaper, insulation, and other flammable materials.
4. The Contractor shall maintain a fully charged ABC-type 9 kg fire extinguisher in the work area, as required by OSHA regulations.
5. The Contractor shall allow the heat stream leaving the gun to merely soften the paint. Do not allow the paint film to scorch or smoke. At the first sign of paint softening, blistering, or bubbling, remove the heat stream and manually scrape the softened paint from the substrate. Heat gun removal shall begin at the highest point on the surface and proceed to the lowest point.
6. The Contractor shall maintain sharp scraper blades to minimize surface abrasion and gouging of the substrate. The Contractor shall have sufficient additional blades on site; scraper blades shall be selected for the surface being abated.
7. To obtain a smooth finish, the Contractor may need to follow heat gun activities by wet sanding or HEPA-sanding the surface following procedures outlined in these Specifications, as directed by the COTR.

C. HEPA Vacuum Needle Gun:

1. HEPA-equipped needle guns are permitted for abatement of lead-containing material from metal substrates only and may damage other surfaces.
2. The Contractor shall select the proper shroud as recommended by the manufacturer to match the configuration of the substrate being abated.
3. The Contractor shall operate the HEPA-vacuum attachment at all times for the duration of the lead-containing material abatement.

D. HEPA Vacuum Blasting:

1. The Contractor shall conduct blasting on flat, exterior surfaces or on surfaces compatible with available blast heads as recommended by the equipment manufacturer.

2. The Contractor shall maintain blast head in contact with the lead-containing surface to provide maximum collection of dust and debris created by the blasting operation.

E. Machine HEPA Sanding:

1. Machine sanding without a HEPA-filtered vacuum attachment is prohibited. When using a sander equipped with a HEPA-filtered vacuum, the Contractor shall strictly follow the manufacturer's operating instructions and instructions for care and maintenance.
2. During HEPA sanding, the Contractor shall maintain the operation of the HEPA-vacuum attachment during all sanding operations. The sanding surface shall be held flat to the paint surface. Sanding operations shall be conducted on flat surfaces only.
3. The Contractor shall not allow the sanding pad surface to extend beyond the surface being sanded. The potential for the production of airborne lead dust increases when the sanding disk is wider than the surface being abated.
4. HEPA sanding is not permitted on detailed moldings.

F. Prior to reoccupancy by trade workers or personnel without a minimum of lead awareness training, the work area shall be cleaned and properly cleared for reoccupancy based upon final clearance testing as specified herein.

3.14.6 Lead-Contaminated Soil Removal

A. Contractor shall prepare work areas where lead-contaminated soil is removed as work areas exceeding the OSHA Action Level unless the Contractor can provide a NEA for the specific work activity demonstrating that the documented engineering controls and work practices are effective in controlling airborne lead concentrations below the OSHA Action Level as specified in these Specifications.

B. The Contractor shall carefully remove existing fencing to allow access; erect temporary fencing, signs, and barrier tape as outlined in the Preparation of Abatement Work Area - Exterior section of these Specifications.

C. The Contractor shall tie and protect existing trees, shrubs, and bushes in the work area.

D. The Contractor shall use hand-held spray equipment to dampen soil. Do not over saturate and cause water to run onto adjacent areas.

E. The Contractor shall remove existing lead-contaminated soil using shovels or HEPA-vacuum loading equipment starting at the point farthest from the decontamination unit. Remove a minimum depth of 150 mm of lead-contaminated soil, or as directed by the COTR.

F. Do not track through areas where soil has been removed.

G. At the end of each shift, or during periods of excessive winds, cover lead-contaminated sections of soil with one layer of 0.15 mm (six-mil) poly sheeting; anchor sufficiently to prevent the migration of the poly.

H. Replace the removed soil at proper grade to allow drainage. Replacement soil shall be at least 50 mm above existing grade to allow for settling. Soil must contain less than 400 ppm of lead.

I. Install new soil covering (e.g., grass or sod). The Contractor shall consult with the Smithsonian Institution Office of Horticulture Services when selecting an appropriate grass or sod covering.

3.14.7 Encapsulation of Lead-Containing Surface Coatings

A. Contractor shall prepare work areas where lead-containing materials are to be encapsulated as work areas exceeding the OSHA Action Level unless the Contractor can provide a NEA for the specific work activity demonstrating that the documented engineering controls and work practices are effective in controlling airborne lead concentrations below the OSHA Action Level as specified in these Specifications.

B. Encapsulation:

1. Surfaces of non-deteriorated substrates covered with intact lead-containing material may be considered for encapsulation.
2. Conduct field tests of surfaces to be encapsulated for paint film integrity. Test the adhesion by performing a minimum 150 mm x 150 mm test patch. The area must be visually clean of dust and debris before performing the test patch. Conduct a minimum of one test patch on each type of lead-containing material covered building component to which the encapsulant will be applied.
3. The following surfaces and components are typically not suitable for encapsulation. Alternate interim control or abatement methods shall be considered for the following:
    a. Friction surfaces, such as window jambs and door jambs. Friction surfaces are typically subject to repeated damage, thereby compromising the integrity of the encapsulant applied.
    b. Surfaces with substrates or existing coatings that have a high level of deterioration. Encapsulants on these surfaces have a high rate of failure as a result of the surface or substrate deterioration.
    c. Surfaces in which there is a known incompatibility between two existing surface coating layers. This incompatibility typically cannot be determined without performing a test patch of the surface.
    d. Surfaces that cannot support the additional weight stress of encapsulation due to existing paint thickness. This inability to support the additional weight of an encapsulant typically cannot be determined without performing a test patch of the surface.
    e. Metal surfaces that are prone to rust or corrosion. Encapsulants on metal surfaces typically fail when the surface underneath rusts.
4. Repair all building components and substrates as needed (e.g., caulk cracks and repair sources of water leaks).

5. Prepare surfaces. Remove all dirt, grease, chalking paint, mildew and other surface contaminants, remnants of cleaning solutions, and loose paint. All surfaces shall be de-glossed, as needed.
6. Apply one of the three following types of encapsulant, as approved by OSHEM and directed by the COTR.
   a. Non-reinforced liquid coatings
      1) Apply using a brush, roller or spray. Non-reinforced liquid coatings are suitable for many interior and exterior substrates. Application procedures and requirements vary with specific type selected; follow manufacturer's directions during application.
   b. Reinforced liquid coatings:
      1) Apply using a brush, roller, spray, or trowel. Application procedures for reinforced liquid encapsulants vary with specific type selected and may require the application of a fabric; follow manufacturer's directions during application.

      NOTE: Use of liquid coatings is prohibited in the State of Maryland for residential, child-occupied, commercial and steel structures. Approval for use in other jurisdictions will be on a case-by-case basis.

   c. Adhered materials (e.g., vinyl wall coverings, vinyl floor tile, etc.):
      1) Contractor shall apply adhesive first, then install the selected encapsulant product. The Contractor shall carefully follow the manufacturer's directions for application of adhesive product and encapsulant selected.
7. During encapsulant application or installation, monitor air temperature and relative humidity and perform the encapsulant application according to the manufacturer's guidelines for these parameters. For liquid coatings, monitor the coating thickness to ensure that the encapsulant manufacturer's Specifications are met.
8. For liquid coating encapsulants, allow coating to cure and then visually examine it for wrinkling, blistering, cracking, bubbling, or other chemical reaction with the underlying paint. For all encapsulants, perform the appropriate adhesion tests recommended by the manufacturer.
9. The COTR will conduct regular evaluations of the encapsulated area and report defects or deterioration to the Contractor for re-stabilization.

C. Prior to reoccupancy by trade workers or personnel without a minimum of lead awareness training, the work area shall be cleaned and properly cleared for reoccupancy based upon final clearance testing as specified herein.

3.14.8 Cleaning of Lead-Contaminated Surface Dust

A. Contractor shall prepare work areas where lead-contaminated surface dust cleaning work activities are performed as work areas exceeding the OSHA Action Level unless the Contractor can provide a NEA for the specific work activity demonstrating that the documented engineering controls and work practices are effective in controlling airborne lead concentrations below the OSHA Action Level as specified in these Specifications.

B. Dust Removal and Control:

1. The removal and control of lead-contaminated dust shall be performed for those building surfaces with lead dust levels above those in the following table, and as directed by the COTR.

Surface	Leaded Dust Loading ($\mu g/ft^2$)
Bare and Carpeted Floors	40
Interior Window Sills	250
Window Troughs	400
Exterior Horizontal Surfaces	400

2. Correct any known or suspected lead-containing surface coating hazards which may be contributing to the production of lead-contaminated dust before dust removal, as directed by the COTR.
3. Visually inspect other dust traps (e.g., radiators, floor grates, etc.). If visible dust is observed, the item shall also be cleaned.
4. Clean all horizontal surfaces by HEPA vacuuming and by wet wiping techniques, as directed by the COTR.
5. Begin dust removal at the highest horizontal surface and work down. Clean windows, other dust traps, and finally the floors.
6. During wet cleaning, replace rags, sponges, and mops frequently. Change the wash water often.
7. To discard lead-contaminated carpets or other upholstered furnishings, as directed by the COTR, mist the surface with water; seal the item in plastic sheeting, bags, or containers; and discard properly.
8. To clean lead-contaminated carpets or other upholstered furnishings, HEPA vacuum each surface a minimum five times, vacuuming the bottom of the item a minimum of three times. Also HEPA vacuum the existing floor below lead-contaminated carpeting a minimum of three times.

3.14.9 Interim Control of Lead-Contaminated Soil

A. Contractor shall prepare work areas where lead-contaminated soil cleaning work activities are performed as work areas exceeding the OSHA Action Level unless the Contractor can provide a NEA for the specific work activity demonstrating that the documented engineering controls and work practices are effective in controlling airborne lead concentrations below the OSHA Action Level as required in these Specifications.

B. Soil Interim Controls:

1. The interim control of lead-contaminated soil shall be performed for those surfaces with lead-in-soil levels below the levels in the following table, and as directed by the COTR. Interim controls are not appropriate, and abatement should be considered for lead-contaminated soil with lead concentrations above the levels in the following table.

Soil Area	Lead in Soil Level (µg/g)
SI Child Care Play Areas	400
Other Soil Areas	1,200

2. Interim control measures for lead-contaminated soil include installing surface coverings (e.g., grass, gravel, etc.) or implementing land use controls in the area (e.g., fencing the area, creating alternative walkways, etc.).
3. The Contractor shall perform the interim control of lead-contaminated soil according to the following general guidelines, and as directed by COTR (the interim control of lead-contaminated soil in a selected area may involve the selection of one or a combination of a number of controls, to be coordinated with COTR):
    a. If the area to be controlled is heavily traveled, grass surface coverings may not be appropriate and more durable coverings such as gravel or pavement should be considered. Consult with the COTR.
    b. When seeding or installing sod on a selected area, the Contractor shall consult with the Smithsonian Institution Office of Horticulture Services to determine what grasses are appropriate for the locale, soil type, and sun/shade characteristics. Properly prepare the soil prior to seeding or sodding.
    c. When covering lead-contaminated soil with bark or gravel, apply the covering at least 150 to 300 mm deep. New bark, gravel, or other materials shall not contain more than 200 µg/g of lead. The Contractor shall test these materials for lead content prior to installation, unless previous testing data are available and provided to the COTR.
    d. If the lead-contaminated soil is in a Smithsonian Institution child care recreation area, the Contractor shall comply with the Consumer Product Safety Commission standards on acceptable surface coverings in play areas.
    e. Implementing land use controls to reduce exposure to the lead-contaminated soil include installing fencing, warning signs, and thorny bushes. The Contractor shall obtain COTR permission prior to implementing any land use control.
    f. Control water erosion by proper grading and installation of drainage channels, as directed by the COTR.
    g. Provide walk-off doormats at all adjacent building entryways to reduce the tracking of lead-contaminated soil into the building.

3.14.10 Work Activities Impacting Lead Not Addressed

A. Any work activities impacting lead that have not been addressed by these Specifications must be conducted in accordance with all applicable EPA, OSHA, and local regulations. In addition, the engineering controls and work practices for all work activities impacting lead or assumed to impact lead must be submitted in writing to the COTR for pre-approval prior to mobilization.

3.15 OPERATIONS AND MAINTENANCE PROCEDURES AND CONTROLS

A. Preparation of work area for O&M during lead-containing material penetration and cutting:

1. Move furnishings and equipment away from the work area. Objects which are fixed-in-place shall be covered with 2 layers of six-mil poly drop cloth.
2. Place 2 layers of six-mil poly drop cloth on the floor and extend cloth at least five feet (1,500mm) from all areas of lead-containing material work.
3. If wall is within 1,500mm of work area perimeter, turn drop cloth up a minimum of 300 mm from the base of the wall and seal to the wall with tape.
4. If liquid runoff is to be generated, roll up edges of drop cloth to create a berm which will contain the liquid waste and debris.
5. Limit access through the work area by demarcating entrance areas to help control traffic with OSHA approved lead caution tape.

B. Work procedures for penetrating or cutting lead-containing material covered surfaces:

1. As a minimum, disposable gloves and shoe coverings are to be worn by individuals performing O&M work to prevent the spread of lead paint dust to other areas. Eye protection, head protection (for overhead work), and full-body protection is recommended.
2. Power tools used for O&M work shall be equipped with a HEPA-filtered, shrouded exhaust. As an alternative, power tools may be used in conjunction with HEPA-filtered vacuum cleaners held in close proximity to source of dust, provided that, in the judgment of the COTR, this method is shown to result in acceptable dust suppression.
3. Initially mist the work surface area with a water and surfactant solution.
4. Use utility knife or scraper to remove any loose paint from the work surface or to slice the painted edges of the component to be removed from the work surface. Reference wet scraping procedures per this specification to remove paint along the cutting line prior to undercutting doors.
5. Perform the required work on the surface while the surface is wet. Re-wet the surface as needed during penetrating and cutting work.
6. Disconnect power tools during wetting procedures to avoid electrical shock.
7. Ensure that during penetrating and cutting work that lead dust and debris remains on the drop cloth. If dust and debris spreads to other areas, use procedures in the specification for full-scale work area preparation, worker protection and work area cleaning.
8. After completing work, disconnect power tools and re-mist the work surfaces.
9. Clean and rinse all equipment and work surfaces using a wet wash system as covered in the Specifications.
10. Remove shoe covering when stepping off the poly drop cloth.
11. The Smithsonian Institution may conduct a visual inspection and lead clearance testing in compliance with the Specifications. The Contractor shall consult with the COTR regarding final visual inspection and clearance testing prior to start of work activities.
12. After completion of clearance testing, or notification from the COTR, drop cloths shall be rolled inward and placed in disposal bags with other waste. Waste generated during O&M work may be regulated as a hazardous waste under RCRA per this specification. The SI IH shall collect a representative sample of the generated waste for TCLP analysis.

3.16 LEAD WORK AREA CLEANING PROCEDURES

A. Daily Cleaning:

1. The Contractor shall carefully fold the drop cloth to center and dispose of the poly drop cloth as lead-contaminated waste.

2. The Contractor shall provide general clean-up of lead work area concurrent with the removal of all lead-containing or lead-contaminated materials. Do not permit accumulation of debris on the work area floor.
3. The Contractor shall perform a thorough HEPA vacuuming of the work area. In addition, the Contractor shall utilize an effective cleaning solution during the cleaning activities. Do not perform dry dusting or dry sweeping.
4. The Contractor shall reinstall a clean poly drop cloth before resuming the Work.

B. Final Cleaning at the Completion of Work:

1. The Contractor shall remove all visible accumulations of lead-containing material and debris.
2. The Contractor shall HEPA vacuum all surfaces in the work area, then wet clean the surfaces with an effective cleaning solution; HEPA vacuum all surfaces in the work area again.
3. The Contractor shall thoroughly decontaminate and remove all equipment from the work area.
4. If applicable, the Contractor shall replace all HEPA filters and pre-filters in air filtration units exhibiting diminished flow capacity with clean filters. Clean all air filtration units.
5. The Contractor shall perform no activity in the work area for a minimum of one hour to allow settlement of airborne particulate. No reduction in this settling time will be permitted.
6. The Contractor shall notify the SI IH for observation of cleaning to determine completeness. Poly surfaces will be considered clean when free from visible dust, dirt, residue, film, or discoloration resultant from the Work.
7. Following successful visual inspection as outlined in these Specifications, the Contractor shall dismantle and carefully remove remaining poly sheeting except for critical barriers.
8. The Contractor shall HEPA vacuum all surfaces in the work area, and then wet clean the surfaces with an effective cleaning solution. Allow surfaces to dry, and HEPA vacuum all surfaces in the work area again.
9. If applicable, the Contractor shall replace all HEPA filters and pre-filters in air filtration units with clean filters. Clean all air filtration units again. Notify the SI IH for observation of cleaning to determine completeness. Work area will be considered clean when free from visible dust, dirt, residue, film, or discoloration resultant from the Work.
10. Following successful visual inspection as outlined in these Specifications, the SI IH will perform appropriate clearance sampling in the work area.

3.17 LEAD WORK AREA CLEARANCE PROCEDURES

A. Visual Inspection:

1. All surfaces within the lead work area will be visually examined by the SI IH. The SI IH will examine the bare surfaces to ensure that there is no visible residue. If residue remains, the Contractor shall re-clean the component prior to repeating the visual inspection.
2. If a building component has been removed and replaced, the SI IH will examine the work area to ensure that each building component specified for removal and replacement has been completely removed.
3. If a lead-containing surface coating- enclosure system has been installed, the SI IH will examine the mechanical fastening system used to hold the enclosure to the substrate to

determine that the fastening system is adequate. All seams and edges in the enclosure will be examined to ensure that they are sealed to provide a dust tight system.

4. If lead-contaminated soil abatement has been performed, the SI IH will examine the work area to ensure that no visible paint chips are present in the soil following the Work. The SI IH will examine all soil areas selected for abatement to document that each has been completely treated, or removed, as specified.
5. If an interim control method has been performed, the SI IH will examine the work area to ensure that the lead hazard control method performed (e.g., encapsulation, paint film stabilization, friction and impact surface treatment, etc.) has been completed.
6. There shall be no evidence of settled dust following the Contractor's cleanup effort regardless of activity. Any settled dust present in the lead work area during the visual inspection provides sufficient evidence that the Contractor's cleanup effort was not adequate. The areas immediately outside the lead work area will also be visually examined to confirm that no leaded dust or paint chips have been transferred outside the work area.

B. Lead Wipe Sampling:

1. For interior work, the SI IH will follow the following guidelines: a minimum of one wipe sample will be collected for every 200 square meters of floor surface area inside the work area; and a minimum of one sample will be collected from each window inside the work area, alternating between interior window sill and window trough samples (actual number and specific locations of samples will be determined by the SI IH). In addition, one wipe sample will be collected outside the work area within a 3-meter radius of the entrance to the decontamination unit.
2. For exterior work, the SI IH will follow the following guidelines: a minimum of one wipe sample will be collected for every 200 square meters of horizontal surface area (e.g., a porch floor or an entryway) inside the work area, and one wipe sample will be collected from approximately every other window trough inside the work area (actual number and specific locations of samples shall be determined by the SI IH). In addition, one wipe sample will be collected outside the work area within a 3-meter radius of the entrance to the decontamination unit.
3. Cleaning shall be considered complete when every lead dust wipe sample is below the following levels (given in micrograms of lead per square foot):

Surface	**Leaded Dust Loading ($\mu g/ft^2$)**
Bare and Carpeted Floors	40
Interior Window Sills	250
Window Troughs	400
Exterior Horizontal Surfaces	400

4. The Contractor shall re-clean those areas which do not comply with the specified final clearance levels. Following re-cleaning efforts, visual inspection and clearance sampling shall be performed to ensure that the re-cleaning was effective. The Contractor is responsible for the cost incurred during re-cleaning activities.

C. Lead Soil Sampling:

1. Following an exterior lead-containing material abatement or interim control, the SI IH will collect a minimum of one composite soil sample from the perimeter of the area adjacent to the exterior work area. If only selected areas of the building were abated, the composite sample will be collected from that area only. One additional composite soil sample will be collected from each adjacent area, and one will be collected from each adjacent Smithsonian Institution child care play area. During sampling, bare soil shall be collected from the sampling area. If no bare soil is present, the soil covering (e.g., grass, mulch, etc.) shall be sampled to determine if it has been contaminated by the work.
2. Abatement shall be considered complete when each composite lead soil sample is at or below the following levels (given in micrograms of lead per gram of soil):

Soil Area	Lead in Soil Level (µg/g)
SI Child Care Play Areas	400
Other Soil Areas	1,200

3. If lead in soil levels are greater than or equal to the applicable limits, additional soil treatment may be required. Additional soil treatment shall be performed according to the procedures outlined in these Specifications, and as directed by the COTR. The Contractor is responsible for the cost incurred during additional soil treatment activities.

3.18 REMOVAL OF ENGINEERING CONTROLS

A. Following successful final clearance testing and acceptance of results by COTR, the Contractor shall leave air filtration units running until critical barrier removal has been completed.

B. Equipment, machinery, scaffolding, tools, etc., within the work area shall not be removed without first being thoroughly cleaned by HEPA vacuuming and wet wiping with cleaning solution.

C. If applicable, before removing air filtration units from the work area, the Contractor shall remove and properly dispose of pre-filters, decontaminate the exterior of each air filtration unit, and seal the intake to each unit with 0.15 mm (six-mil) poly sheeting. Wrap entire unit with one additional layer of 0.15 mm (six-mil) poly sheeting.

D. After clearance results have been accepted by the COTR, the critical barrier poly seals have been removed, and the poly sheeting, tape, and any other trash and debris have been disposed of properly, the SI IH and the COTR will conduct a final walkthrough of the work area.

E. The Contractor shall repair, patch and paint all damaged areas and restore them to their original, pre-contract condition.

F. Subsequent to the lead work activities, the Contractor shall perform the following before the Work may be considered for completeness:

1. The work area has been cleaned in accordance with the procedures outlined in these Specifications.
2. Visual clearance examinations and testing have been performed and the results have been accepted by the COTR.
3. Engineering controls have been removed from the work area, and the waste generated during the Work has been removed from the site and disposed of in accordance with these Specifications.

3.19 WASTE MANAGEMENT

A. General:

1. The Contractor shall properly store and secure all waste at all times. Do not leave debris in the work area or in uncovered or unlocked trucks or dumpsters. Do not leave any waste in unsecured areas accessible to the public. Do not incinerate debris or use any unauthorized dumpster. Do not introduce lead-contaminated water into storm or sanitary sewers. Do not permit recycling of building components coated with lead-containing material.
2. All materials, whether hazardous or non-hazardous, shall be disposed of in accordance with all applicable federal, state, and local regulations. Keep all chemicals and chemical waste in sealed and properly labeled containers. The contractor shall not discard chemicals in trash or down drain. Do not evaporate surplus waste solvents.
3. The Contractor shall maintain on site the name of and contact information for the building's designated Smithsonian Institution Hazardous Waste Coordinator (HWC).
4. The Contractor shall ensure that there is no leakage of waste or release of dust during the storage and transportation of waste.
5. The Contractor shall make every attempt to minimize the total quantities of waste generated by conducting abatement and interim control efforts that generate reduced quantities of both hazardous and non-hazardous waste for disposal, avoiding commingling of hazardous and non-hazardous waste. Painted metal components should be recycled whenever possible, with required corresponding documentation provided to SI.

B. Hazardous Waste Management:

1. The Contractor shall segregate abatement waste into distinct waste streams (e.g., disposable suits, lead-contaminated polyethylene sheeting, lead-contaminated waste water, hazardous chemical sludge, etc.). Various combinations of each in different containers will not be accepted.
2. Lead-containing or lead-contaminated waste shall be considered as hazardous waste, and labeled in accordance with this specification, unless:
    a. Lead leachate concentrations of the waste are determined to be less than 5 ppm from representative bulk samples, by TCLP analysis, following the protocol indicated in EPA regulations.
    b. The waste does not meet any other regulatory definitions as "hazardous waste" per section 1.4 (A) (29) of these Specifications.

3. Waste tested which results in a lead leachate concentration of greater than or equal to 5 parts per million shall be considered hazardous and shall be handled and disposed of as such according to local, state, and federal regulations.
4. All TCLP test results shall be permanently retained by the Smithsonian Institution.
5. Lead waste from lead abatement projects completed in residential or child-occupied facilities must be removed from the site within 48 hours after completing cleanup. All other hazardous waste must be removed from the site of a lead abatement project within 90 days of completion of the project.
6. The Contractor shall not discard chemicals in trash or down drains. Do not evaporate surplus waste solvents. Keep chemical waste in appropriate, sealed containers.

C. Containers:

1. The Contractor shall comply with EPA, DOT, and all other applicable federal, state, and local regulations for hazardous waste containers. All hazardous waste containers shall be completely sealed and shall be checked for tightness prior to removal from the work area.
2. All non-hazardous lead waste may be contained in one of the following:
   a. Sealed disposal drums:
      1) Contractor shall provide sufficient extra caps, rings, gaskets, etc., in the event of drum leakage. Replacement of caps, rings, gaskets, etc. shall not occur without the permission of the COTR.
      2) All disposal drums shall be new; no used or damaged disposal drums are acceptable (the Contractor shall provide sufficient dollies or other suitable means of transporting the drums as approved by the COTR).
      3) Each filled, sealed drum shall be tipped by the Contractor in the presence of the SI IH prior to removal from the work area.
   b. Two layers of 0.15 mm (six-mil) thick poly sheeting, sealed with adhesive spray and duct tape
   c. Two layers of 0.15 mm (six-mil) thick poly disposal bags; each bag shall be sealed by ‘goose-necking’ the bag with duct tape.

D. Storage Requirements:

1. The Contractor shall notify the COTR, who will then notify the HWC when hazardous waste containers start being filled.
2. The Contractor shall keep all waste materials, both hazardous and non-hazardous, inside the work area during the Work.
3. Contractor shall coordinate with the COTR, if necessary, a designated storage area in the building where waste, both hazardous and non-hazardous, may be stored following removal from work area and prior to removal from site. The designated storage area shall be a secured area or lockable container that is inaccessible to all persons other than the Contractor and the COTR.

E. Labeling Requirements:

1. The Contractor shall label each hazardous waste container with the words “HAZARDOUS WASTE LEAD, EPA ID# D008.
2. The Contractor shall mark each hazardous waste container on the exterior with the accumulation start date. The accumulation start date is that date when a bulk waste disposal container starts to be filled, or when a chemical that will be disposed of is no longer needed.

F. Waste Control Logs:

1. The Contractor shall keep a Waste Control Log (SF-3) of all hazardous waste containers. The SI IH will review the log for accuracy and completeness. The waste hauler shall include a completed copy of SF-3 when submitting the Hazardous Material Profile Sheets. Profile sheets will not be accepted without a copy of the completed log. Profile sheets shall be sent directly to the COTR.
2. All major constituents and hazardous components of the waste shall be identified by chemical name, not by acronym or trade name.

G. Transportation and Disposal:

1. The Contractor shall transport lead waste containers out of the work area either through the decontamination unit or through a separate waste load-out unit, in accordance with these Specifications.
2. Waste load-out shall be done by two teams. The team inside the work area shall clean the outside of properly labeled lead waste containers using HEPA-filtered vacuums and wet wiping, and place them into the decontamination unit. No personnel from the inside team shall exit any further from the work area. The team outside the work area (wearing appropriate protective equipment) shall retrieve the waste containers from the decontamination unit, double-bag the bagged waste, and pass the waste containers to the uncontaminated area outside the decontamination unit. No personnel from the "outside team" shall enter the work area.
3. The Contractor shall line the routes to the elevator, the elevator itself, and routes to covered carts with 0.15 mm (six-mil) poly sheeting, as applicable, and as directed by the COTR.
4. The Contractor shall perform the removal of hazardous material from public buildings after the building has closed, during non-public hours, and when limited staff is in attendance; arrange with the COTR specific schedule for the removal of hazardous waste. The Smithsonian Institution reserves the right to restrict when containerized waste will be moved outside of the work area and pass through the building.
5. The Contractor shall coordinate with the COTR within 45 days after the accumulation start date for removal from the site and disposal.
6. Prior to removal from the site, each hazardous waste container shall be weighed and its exact weight recorded on the waste manifest. Waste manifests that include estimated weights will not be accepted. Note: Estimated weights on the Hazardous Material Profile Sheets are acceptable.
7. The Contractor shall provide one copy of the completed Hazardous Waste Manifest to the COTR no less than five days prior to the scheduled date of removal from the site; COTR will review the completed manifest for accuracy and completeness.
8. All hazardous waste shall be hauled by a licensed hazardous waste hauler with all required licenses from all state and local authorities with jurisdiction. The licensed hazardous waste hauler shall provide evidence of previous experience transporting lead-contaminated waste. The licensed hazardous waste hauler shall provide permanent labeling for all containers as required by all federal, state, and local regulations.
9. Hazardous and non-hazardous waste shall be disposed according to all federal, state and local regulations.

3.20 JOB CLOSE-OUT

A. The Contractor shall remove from the site all remaining debris and rubbish resulting from removal and disposal operations and the construction of containment's and decontamination units.

B. The Contractor shall demonstrate to the COTR that any building utilities that were temporarily disabled are now in full service. Notify the COTR when disabled building ventilation systems, electrical power, smoke detectors, and building access/egress passages may safely be re-started or used.

C. The Contractor shall replace those items that were removed from the work area prior to or during the Work.

D. The Work will not be considered complete until all submittals required by these Specifications have been provided to and approved by the COTR.

3.21 POST ABATEMENT NOTIFICATIONS - THE SI WILL NOTIFY THE APPROPRIATE JURISDICTION HAVING AUTHORITY OF ABATEMENT ACTIONS COMPLETED IN SI-OWNED HOUSING.

WASTE CONTROL LOG

Project Location: **OEDC Project:**				**Contractor Name:**		
Container Number	**Container Type**	**Fill Start Date**	**Date Sealed**	**Contractor Superintendent Initials**	**SI IH Initials**	**Container Contents**

CERTIFICATION OF VISUAL INSPECTION AND FINAL CLEARANCE SAMPLING FOR LEAD WORK

The COTR, Contractor, and SI Industrial Hygienist hereby document that the work areas have been visually inspected and there is no visible dust, debris, or residue present in the areas. The COTR also certifies that final sampling results meet clearance Specifications.

OEDC Project No_____ Smithsonian Institution Contract No._____

Project Title/Location_____

_____

Description of the Work_____

Date of Inspection_____

Date and results of final lead wipe samples_____

LEAD ABATEMENT CONTRACTOR
Firm_____
Print Name_____
Print Title_____
Signature_____

SI INDUSTRIAL HYGIENIST
Firm_____
Print Name_____
Print Title_____
Signature_____

SI COTR
Firm_____
Print Name_____
Print Title_____
Signature_____

END OF SECTION 028300

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Miscellaneous Cast-In-Place Concrete that includes Guard Booth slab and associated exterior pads.

1.2 SUBMITTALS

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

B. Other Action Submittal:

1. Design Mixtures: For each concrete mixture.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Comply with the following sections of ACI 301, unless modified by requirements in the Contract Documents:
1. "General Requirements."
2. "Formwork and Formwork Accessories."
3. "Reinforcement and Reinforcement Supports."
4. "Concrete Mixtures."

5. "Handling, Placing, and Constructing."

C. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

PART 2 - PRODUCTS

2.1 FRAMEWORK

A. Furnish formwork and formwork accessories according to ACI 301.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, Type I.

a. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregate: ASTM C 33, graded, 3/4-inch nominal maximum aggregate size.

C. Water: ASTM C 94/C 94M.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: Not Permitted.

2.5 RELATED MATERIALS

A. Adhesive Anchoring System: Manufactured system for anchoring reinforcing steel into solid base materials:
   1. Available Manufacturer's:
      a. "Hit HY-200 Max" by Hilti Inc.
      b. "AC100+ Gold" by Powers Fasteners.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable

2.7 CONCRETE MIXTURES

A. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, as follows:
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.45.
   3. Slump Limit: 5 inches, plus or minus 1 inch.
   4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

2.8 CONCRETE MIZING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
   1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

3.2 EMBEDDED ITEMS

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

3.3 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Locate and install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

A. Comply with ACI 301 for placing concrete.

B. Do not add water to concrete during delivery, at Project site, or during placement.

C. Consolidate concrete with mechanical vibrating equipment.

3.6 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding 1/2 inch.

   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch.

   1. Apply to concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.3.7 SITE IMPROVEMENTS

3.7 FINISHING UNFORMED SURFACES

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

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish.

D. Nonslip Broom Finish: Apply a nonslip broom finish to surfaces indicated and to exterior concrete platforms, steps, and ramps. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

3.8 CONCRETE PROTECTING AND CURING

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

B. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

C. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tapeEND OF SECTION 311000

3.9 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 033000

SECTION 044200 - EXTERIOR STONE CLADDING

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. Stone panels set with individual anchors.
2. Stone panels mechanically anchored on steel strongback frames.
3. Stone panels mechanically anchored on steel stud frames.
4. Stone trim units, including bands, copings, sills, jambs, and soffits.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing inserts and weld plates in concrete for anchoring stone cladding.

1.3 DEFINITIONS

A. Definitions contained in ASTM C119 apply to this Section.

B. IBC: International Building Code.

C. Stone Cladding Assembly: An exterior wall covering system consisting of stone panels together with anchors, backup structure, secondary weather barrier (sheathing), mortar, adhesives, fasteners, and sealants used to secure the stone to the building structure and to produce a weather-resistant covering.

1. Backup structure includes steel strongback frames, steel stud frames and miscellaneous steel framing required to secure stone to the building structure.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the jobsite.

1.5 ACTION SUBMITTALS

A. Product Data: For Sunset Red Granite or approved equivalent, stone accessory, and manufactured product Shop Drawings: Show fabrication and installation details for stone cladding assembly, including dimensions and profiles of stone units.

1. Show locations and details of joints both within stone cladding assembly and between stone cladding assembly and other construction.
2. Include details of mortar joints, sealant joints and, mortar joints pointed with sealant.
3. Show locations and details of anchors and backup structure.
4. Show direction of veining, grain, or other directional pattern.
5. Include large-scale shaded elevations and details of decorative surfaces and inscriptions.

B. Samples for Initial Selection: For joint materials involving color selection.

C. Stone Samples for Verification: Sets for each variety, color, and finish of stone required; not less than 12 inches square.

1. Sets shall consist of at least six Samples, exhibiting extremes of the full range of color and other visual characteristics expected and will establish the standard by which stone will be judged.

D. Colored Pointing Mortar Samples for Verification: For each color required. Make Samples using same sand and mortar ingredients to be used on Project.

E. Sealant Samples for Verification: For each type and color of joint sealant required.

F. Delegated-Design Submittal: For stone cladding assembly.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, professional engineer and testing agency.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate stone cladding assemblies similar to that required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: A firm or individual experienced in installing stone cladding assemblies similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical exterior wall area not less than 24” (610 mm) long by 42” (1069 mm) high.

a. Include typical components, attachments to building structure, and methods of installation.
b. Include sealant-filled joint complying with requirements in Section 079200 "Joint Sealants."

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless COTR specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.

1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.

C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

E. Store aggregates in locations where grading and other required characteristics can be maintained and where contamination can be avoided.

1.9 FIELD CONDITIONS

A. Protect stone cladding during erection by doing the following:

1. Cover tops of stone cladding installation with nonstaining, waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24” (610mm) down both sides and hold securely in place.
2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.
3. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
4. Protect sills, ledges, and projections from mortar and sealant droppings.

B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace stone cladding damaged by frost or freezing conditions. Comply with cold-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.

C. Hot-Weather Requirements: Comply with hot-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.

D. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F or when joint substrates are wet.

1.10 COORDINATION

A. Coordinate installation of inserts that are to be embedded in concrete or masonry, flashing reglets, and similar items to be used by stone cladding Installer for anchoring, supporting, and flashing of stone cladding assembly. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.

B. Time delivery and installation of stone cladding to avoid extended on-site storage and to coordinate with work adjacent to stone cladding.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Stone: Obtain Sunset Red Granite or approved equivalent regardless of finish, from single quarry**,** whether specified in this Section or in another Section of the Specifications, with resources to provide materials of consistent quality in appearance and physical properties.

1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
2. Make quarried blocks available for examination by Architect.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from single manufacturer and each aggregate from single source or producer.

C. Source Limitations for Other Materials: Obtain each type of stone accessory, sealant, and other material from single manufacturer for each product.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stone cladding assembly.

B. General: Design stone anchors and anchoring systems according to ASTM C1242.

1. Stone anchors shall withstand not less than two times the weight of the stone cladding in both compression and tension.

C. Structural Performance: Stone cladding assembly shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Wind Loads: As indicated.
2. Equipment Loads: Allow for loads due to window cleaning and maintenance equipment.

D. Seismic Performance: Stone cladding assembly shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (49 C), ambient; 180 deg F (82 C), material surfaces.

F. Horizontal Building Movement (Interstory Drift): Allow for maximum horizontal building movement equal to quotient resulting from dividing floor-to-floor height at any floor by 400.

G. Safety Factors for Stone: Design stone cladding assembly to withstand loads indicated without exceeding stone's allowable working stress determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:

1. Safety Factor for Granite: 3.
2. Safety Factor for Concentrated Stresses: 4.

H. Design stone anchors and backup structure to withstand loads indicated without exceeding allowable working stresses established by the following:

1. For Structural Steel: AISC 360.
2. For Cold-Formed Steel: AISI's "North American Specification and Commentary for the Design of Cold-Formed Steel Structural Members."
3. For Cold-Formed Stainless Steel: ASCE/SEI 8, "Specification for the Design of Cold-Formed Stainless Steel Structural Members."
4. For Aluminum: AA ADM-1, "The Aluminum Design Manual."

I. Corrosion and Staining Control: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Materials shall not stain exposed surfaces of stone and joint materials.

2.3 GRANITE – Sunset Red Granite

A. Material Standard: Comply with ASTM C615/C615M.

B. Description: Uniform, fine to medium –grained.

C. Acceptable Stone Sources include, but are not limited to, the following:

1. Cold Spring Granite

D. Cut stone from one block or contiguous, matched blocks in which natural markings occur.

E. Finish: Thermal to match COTR's sample.

F. Match COTR's samples for color, finish, and other stone characteristics relating to aesthetic effects.

G. Thickness: 2” (51 mm)

2.4 ANCHORS AND FASTENERS

A. Fabricate anchors, including shelf angles, from stainless steel, ASTM A240/A240M or ASTM A666, Type 316; temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A276, Type 316.

B. Fabricate shelf angles for limestone from hot-dip galvanized steel, ASTM A36/A36M for materials and ASTM A123/A123M for galvanizing.

C. Fabricate anchors, including shelf angles, from extruded aluminum, ASTM B221, alloy and temper as required to support loads imposed without exceeding allowable design stresses, but not less than strength and durability properties of Alloy 6063-T6.

D. Weld Plates for Installation in Concrete: Comply with Section 055000 "Metal Fabrications."

2.5 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction, natural color or white as required to produce mortar color indicated.

1. Low-Alkali Cement: Portland cement for use with limestone shall contain no more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207.

1.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime.

D. Aggregate: ASTM C144; except for pointing mortar, 100 percent shall pass No. 16 sieve.

1. White Aggregates: Natural white sand or ground white stone.
2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.

E. Water: Potable.

2.6 STONE ACCESSORIES

A. Setting Shims: Strips of resilient plastic orvulcanized neoprene, Type A Shore durometer hardness of 50 to 70, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

B. Setting Buttons: Resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of pointing materials.

C. Concealed Sheet Metal Flashing: Fabricated from zinc-tin, alloy-coated stainless steel in thicknesses indicated, but not less than 0.0156” (40 mm) thick.

D. Weep and Vent Tubes: Medium-density polyethylene tubing, ¼” (60 mm) OD or rectangular, cellular, polypropylene or clear butyrate extrusion, 3/8” (10 mm) by 1-1/2” (38mm) of length required to extend from exterior face of stone to cavity behind.

E. Cellular Plastic Weep Hole/Vents: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

F. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, of length required to extend from exterior face of stone to cavity behind, in color selected from manufacturer's standard.

G. Sealants for Joints in Stone Cladding: Manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below and do not stain stone:

1. Joint Sealant: Silicone, nonstaining, S, NS, 100/50, NT.
2. Joint-Sealant Colors: Match color of stone.

2.7 STONE FABRICATION

A. For Granite, fabricate stone units in sizes and shapes required to comply with recommendations in NBGQA's "Specifications for Architectural Granite."

B. Control depth of stone and back check to maintain minimum clearance of 1” (25 mm) between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.

C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.

D. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place.

E. Finish exposed faces and edges of stone, except sawed reveals, to comply with requirements indicated for finish and to match approved samples and mockups.

F. Cut stone to produce uniform joints 3/8” (10 mm) wide and in locations indicated.

G. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

H. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.

1. Produce moldings and molded edges with machines that use abrasive shaping wheels made to reverse contour of molding shape.

I. Clean backs of stone to remove rust stains, iron particles, and stone dust.

J. Inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

2.8 MORTAR MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.

1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated. Do not use calcium chloride.
2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Discard mortar when it has reached initial set.

B. Portland Cement-Lime Setting Mortar: Comply with ASTM C270, Proportion Specification, for types of mortar indicated below:

1. Set granite with Type S mortar.

C. Pointing Mortar: Comply with ASTM C270, Proportion Specification, for types of mortar indicated. Provide pointing mortar mixed to match Architect's sample and complying with the following:
1. Point granite with Type S mortar.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive stone cladding and conditions under which stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone cladding.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING STONE CLADDING, GENERAL

A. Before setting stone, clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. Execute stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.

1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.

C. Contiguous Work: Provide reveals, reglets, and openings as required to accommodate contiguous work.

D. Set stone to comply with requirements indicated. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated, with uniform joints of widths indicated, and with edges and faces aligned according to established relationships and indicated tolerances.

E. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.

1. Sealing expansion and other joints is specified in Section 079200 "Joint Sealants."
2. Keep expansion joints free of mortar and other rigid materials.

F. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water, to divert water to building exterior. Extend flashing 6” (152 mm) at ends and turn up not less than 2” (51 mm) to form end dams.

G. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities with mortar or grout.

1. Place weep holes in joints where moisture may accumulate, including at base of cavity walls and above shelf angles and flashing. Locate weep holes at intervals not exceeding 24” (610 mm). Use weep and vent tubes.

2. Place vents in cavity walls at tops of cavities, below shelf angles and flashing, and at intervals not exceeding 20 feet (6096 mm) vertically. Locate vents in joints at intervals not exceeding 60” (1524 mm) horizontally. Use weep and vent tubes.

3.3 SETTING MECHANICALLY ANCHORED STONE CLADDING

A. Set stone cladding with mechanical anchors without mortar unless otherwise indicated.

B. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C1242.

C. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant indicated for filling kerfs.

D. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

3.4 SETTING STONE CLADDING WITH MORTAR

A. Set stone cladding with mortar and mechanical anchors where indicated.

B. Set stone in full bed of mortar with head joints filled unless otherwise indicated.

1. Use setting buttons of adequate size, in sufficient quantity, and of thickness required to maintain uniform joint width and to prevent mortar from extruding. Hold buttons back from face of stone a distance at least equal to width of joint, but not less than depth of pointing materials.
2. Do not set heavy units or projecting courses until mortar in courses below has hardened enough to resist being squeezed out of joint.
3. Support and brace projecting stones until wall above is in place and mortar has set.
4. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with mortar.

C. Fill space between back of stone units and backup wall solidly with mortar or grout.

D. Embed ends of sills in mortar; leave remainder of joint open until final pointing.

E. Rake out joints for pointing with mortar to depths of not less than ½” (12 mm). Rake joints to uniform depths with square bottoms and clean sides.

F. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply first layer of pointing mortar in layers not more than 3/8” (10 mm) until a uniform depth is formed.

G. Point stone joints by placing pointing mortar in layers not more than 3/8” (10 mm) Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

H. Tool joints with a round jointer having a diameter 1/8” (3 mm) larger than width of joint, when pointing mortar is thumbprint hard.

I. Rake out mortar from sealant-pointed joints to depths required for sealant and sealant backing, but not less than ½” (12 mm). Rake joints to uniform depths with square bottoms and clean sides.

J. Set the following stone cladding with unfilled head joints for installing joint sealants:
1. Copings.
2. Sills.
3. Belt and other projecting courses.

3.5 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated.

3.6 INSTALLATION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed ¼” (6 mm) in 10’ (3048 mm).

B. Variation from Level: For sills, do not exceed 1/8” (3 mm) 10’ (3048 mm).

C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed ¼” (6 mm) in 20’ (6096 mm).

D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus ¼” (6 mm).

E. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8” (3 mm) or a quarter of nominal joint width, whichever is less. For joints within 60” (1524 mm) of each other, do not vary more than 1/8” (3 mm) or a quarter of nominal joint width, whichever is less from one to the other.

F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16” (2 mm) difference between planes of adjacent units.

3.7 ADJUSTING AND CLEANING

A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and stone cladding that does not match approved samples and mockups. Damaged stone may be repaired if Architect approves methods and results.

B. Replace damaged or defective work in a manner that results in stone cladding's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean stone cladding as work progresses. Remove mortar fins and smears before tooling joints. Remove excess sealant and smears as sealant is installed.

D. Final Cleaning: Clean stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION 044200

SECTION 061000 - 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.
2. Wood furring.
3. Plywood backing panels.

B. Related Requirements:

1. Section 09 2216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

1.4 ACTION SUBMITTALS

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

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

1.6 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.

1.7 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings**.**

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Furring.
4. Casework.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Concealed Boards: 15 percent maximum moisture content.

D. 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.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than **1/2-inch (13-mm)** nominal thickness.

2.6 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate **furring,** nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to studs; coordinate locations with subcontractor requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

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.

3.3 INSTALLATION OF WOOD FURRING

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

END OF SECTION 061000

SECTION 07 2100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Mineral-wool blanket.

B. Related Requirements:

1. Section 09 2900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 MINERAL-WOOL BLANKETS

A. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Rockwool International.
c. Thermafiber, Inc.; an Owens Corning company.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 76-mm (3-inch) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 2438 mm (96 inches), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Mineral-Wool Blankets: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 40 kg/cu. m (2.5 lb/cu. ft.).

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 2100

SECTION 07 8413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provision of Contract, including General and Special Conditions and Division 1 Specification Section, apply to work of this section.

1.02 SUMMARY

A. Firestopping is defined as furnishing and installing tested and listed firestopping systems, combinations of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

1.03 DEFINITIONS

A. COTR: Contracting Officer Technical Representative

B. FM: FM Global (Factory Mutual)

C. FPE: Fire Protection Engineer

D. Furnish: To supply the stated equipment or materials

E. Install: To set in position and connect or adjust for use

F. NFPA: National Fire Protection Association

G. NICET: National Institute for Certification in Engineering Technologies

H. OSHEM: Office of Safety Health and Environmental Management

I. Provide: To furnish and install the stated equipment or materials

J. UL: Underwriters Laboratories

1.04 SYSTEM DESCRIPTION

A. Firestopping shall be provided in the following locations:

1. Construction Joints: includes those used to accommodate expansion, contraction, wind, or seismic displacement. The firestopping material shall be a dynamic system and shall not detract from the intended movement of the joint.

2. Penetrations through floor slabs, fire-rated partitions, fire walls, and exterior walls where rated. Firestopping shall be provided for all new penetrations; penetrations left open by demolition/removal of duct, cable, conduit, and pipe; damaged firestopping, and existing abandoned penetrations in the contract area. Unless otherwise specified or shown on the drawings, the Contractor shall assume that all floor slabs are two-hour, fire-rated. Locations of fire walls or partitions shall be indicated on the drawings.

3. Penetrations of vertical shafts: assume a two-hour fire barrier unless noted otherwise.

4. Around openings and penetrations through fire-rated floor/ceiling and roof/ceiling assemblies.

5. Joint systems for floor-to-floor, wall-to-wall, floor-to-wall, and head of wall applications.

B. Other locations shown specifically on the drawings or where called for in other sections of the specifications.

1.05 PERFORMANCE REQUIREMENTS

A. Materials or combinations of materials used for firestopping shall be noncombustible and comply with the following as a minimum:

1. Flame Spread Index: 25 or less, as measured by ASTM E-84

a. Flame Spread Index (FSI) is a relative indication of the flammability of the material of interest with respect to a red oak standard. For example, an FSI of 25 indicates that a material has approximately 25% of the standard material's flame spread characteristics.

2. Smoke Developed Index: 100 or less, as measured by ASTM E-84

a. Smoke Developed Index (SDI) is a relative indication of the amount of smoke produced by a material when exposed to a certain heat source with respect to a red oak standard. The numbers carry the same meaning as the FSI values (25 indicates 25%).

B. Firestopping shall be asbestos free and shall be non-toxic to humans during installation and fire conditions

C. Examination Of Work By The Contractor

1. It shall be the responsibility of the prime contractor to provide firestopping for the entire project. The Contractor shall examine the area to receive firestopping prior to beginning work or to submitting the data required under 1.08, Submittals.

2. Data to be submitted shall be based on the findings of the Contractor's examination.

1.06 SUBMITTALS:

A. Submit the following for approval by the COTR and the OSHEM Fire Protection Engineer. Submit applicable data for each condition specified.

1. Certificates of conformance or compliance, accompanied by classification by a nationally recognized testing lab or by other supporting evidence satisfactory to the COTR and the OSHEM Fire Protection Engineer, that the material or combination of materials used meet the requirements specified for flame spread, smoke developed, and fire resistance.

2. Manufacturer's catalog data for all materials and prefabricated devices, including descriptions sufficient to identify them on the job, and instructions for installation. This data shall also include the Flame Spread Index and the Smoke Developed Index for the materials of interest.

3. Completed construction details (as-builts) showing material, reinforcement, anchorage, fastenings and method of installation. Catalog data with installation diagrams shall also be included. Clearly show which product will be used for each application. [mtw1]Firestopping materials of different manufacturers shall not be intermixed. Do not submit multiple products for the same application. Details for firestopping of penetrations and joint systems shall show compliance with the appropriate UL Design Number. Drawings shall accurately reflect job conditions pursuant to paragraph 1.07 C, Examination of the Work by Contractor.

4. Provide as-built drawings showing all penetration locations on floor plans. An identification key shall provide the rating and construction of the assembly penetrated, and the firestopping assembly used at each location.

1.07 QUALITY ASSURANCE

A. Manufacturers Qualifications: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Society for Testing and Materials (ASTM) Publications:

a) E84 Standard Test Method for Surface Burning Characteristics of Building Materials

b) E119 Standard Test Method For Fire Tests of Building Construction and Materials

c) E814 Test Method of Fire Tests of Through-Penetration Fire stops

d) E1966 Fire Resistive Joint Systems

e) E1399 Cyclic Movement And Measuring The Min & Max Joint Widths of Arch Joint Systems

2. Underwriters Laboratories (UL) Publications:

a) UL-1479 Fire Tests of Through-Penetration Fire Stops

b) UL-2079 Tests for Fire Resistance of Building Joint Systems

c) FRD Fire Resistance Directory

B. Installer's Qualifications. Provide data to show that the firm has at least two years of experience in the installation or application of systems similar in complexity to those required for this project. In addition, provide data to show that the firm is qualified by providing at least 5 comparable scale projects using the manufacturer's systems.

C. Pre-Installation Conference

1. Conduct a pre-installation conference with all sub-contractor representatives to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.

B. Store materials indoors, under cover, above ground, away from moisture, and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.09 COORDINATION

A. Coordinate installation of all penetration firestopping systems with mechanical, electrical, fire protection, and other trades so that installation is complete and to minimize rework due to the addition of penetrants or other modifications.

1.10 WARRANTY

A. Provide a written warranty by the manufacturer against defects in manufacturing and materials and by the installer against defects in workmanship.

PART 2 - PRODUCTS

2.01 GENERAL

A. All firestopping used throughout the project shall be the products of a single manufacturer.

2.02 MANUFACTURERS

A. Hilti

B. 3M

C. Specified Technologies, Inc.

D. Nelson

E. Any manufacturer approved by OSHEM and the COTR

2.03 FIRE RESISTANCE RATING

A. Firestop systems shall be UL Fire Resistance listed or FM P7825a approved with an “F” rating at least equal to the fire-rating of the fire wall or floor in which penetrated openings are to be protected. The “F” rating is permitted to be 3 hours in through-penetrations of 4 hour fire rated walls or floors. Firestop systems shall also have “T” rating where required by any applicable code.

1. F Rating: a rating usually expressed in hours indicating a specific length of time that a fire resistive barrier can withstand fire before being consumed or permits the passage of flame through an opening in an assembly.
2. T Rating: a rating usually expressed in hours indicating the length of time that the temperature on the non-fire side of a fire-rated assembly exceeds 325 degrees above its ambient temperature.

2.04 THROUGH-PENETRATIONS

A. Firestopping materials for through-penetrations shall provide “F” and “T” fire resistance ratings in accordance with ASTM E 814 or UL 1479.

2.05 CONSTRUCTION JOINTS AND GAPS

A. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION:

A. Prior to application, remove from surfaces all dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting or required fire resistance of the firestopping material for cast-in-place firestop devices. Formwork or metal deck to receive device prior to concrete placement and shall be sound and capable of supporting the device. Prepare surface as recommended by the manufacturer.

3.02 INSTALLATION:

A. Install in accordance with approved construction drawings (shop drawings), approved manufacturer's literature, installation instructions, UL Design Number or UL Report, and the following requirements:

B. Firestopping caulks must be installed in a neat and workmanlike manner. The finished installation shall have neat edge lines and a smoothed surface without excess masses of rough caulk on the surface of the wall.

C. Firestopping materials shall completely fill the void space regardless of geometric configuration, subject to tolerances established by the manufacturer when intumescent materials are used.

D. Apply firestopping materials at penetrations of insulated pipes and ducts, prior to application of the insulation. If insulation is already in place, remove it at the penetration prior to application of the firestopping materials, except where intumescent materials are used and removal is not necessary per manufacturer's instructions. Removed insulation shall be replaced with a material having equal thermal insulation characteristics and equal firestopping characteristics.

E. Firestopping for filling voids in floors, in which the smallest dimension is 101 mm (4 inches) or more, shall support the same load as the floor is designed or shall be protected by a permanent barrier to prevent loading or traffic on the fire stopped area.

F. Cable tray penetrations shall be protected by either UL-listed through penetration fire stop devices or through penetration fire stop systems that are re-enterable. Where penetrating cables in a cable tray are removed, replaced, or added, restoration shall be accomplished in an approved manner; the allowable number of penetrating items shall not be exceeded; only permitted penetrations shall be installed; and adequate clearances shall be maintained among penetrations, between penetrations, and the sides of the opening.

G. Damaged, disrupted, or removed firestopping shall be replaced with new.

H. Firestopping shall not be applied in conjunction with fire dampers, smoke dampers, or combination fire/smoke dampers unless specifically required by the damper manufacturer installation instructions.

3.03 INSPECTION

A. Approved installation instructions shall be present at each work area prior to the beginning of work and a test installation shall be produced for quality check by the COTR and OSHEM Fire Protection Engineer. The test installation shall be subject to inspection and/or test for conformance with contract requirements. Periodic quality checks shall be performed at the discretion of the COTR, and should installation prove to be substandard, all firestopping installed up to that time, not meeting approved standards, shall be replaced at no additional cost to the Government.

B. Area of work shall remain available for inspection by the COTR or his designated representative before and after application of firestopping.

C. Notification: Notify the COTR or his designated representative at least 24 hours prior to installation of firestopping in each area to allow opportunity for inspection.

D. The contractor shall submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers. Contractor records shall be maintained on site and provided to the COTR upon arrival for inspections.

3.04 ACCEPTANCE OF WORK

A. Acceptance of Work: As work is completed, remove materials, litter, and debris. All work shall be inspected and accepted by the Contracting Officer and OSHEM Fire Protection Engineer before materials and equipment are moved to the next scheduled work area.[JTS2] Insulation work and/or ceiling and wall close-in shall not occur before OSHEM acceptance has been obtained.

B. Labeling: Upon completion of unfinished areas only, affix label to or adjacent to each fire stopped penetration or joint assembly in fire-rated assemblies indicating material and proper replacement, if later disturbed. Suggested label is as follows:

ATTENTION

THIS IS A **FIRE-RATED ASSEMBLY**

BEFORE BREACHING

CONTACT BUILDING MANAGER AND PROJECT COTR

Hr Rating: _____ Installed by:

Install Date: _____ Company: _____

UL Design #: _____ Employee: _____

END OF SECTION 07 8143

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Mildew-resistant joint sealants.
3. Latex joint sealants.

B. Related Requirements:

1. Section 09 2900 "Gypsum Board" for sealing joints in sound-rated construction.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

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

1.7 FIELD CONDITIONS

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

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

1.8 WARRANTY

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

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

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by COTR from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Dow Corning Corporation; 999-A.
   b. GE Advanced Materials - Silicones; Construction SCS1200.
   c. Pecora Corporation; 860.
   d. Tremco Incorporated; Proglaze.

2.3 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. May National Associates, Inc.; a subsidiary of Sika Corporation.
   b. Pecora Corporation.
   c. The Dow Chemical Company.
   d. Tremco Incorporated.

2.4 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. May National Associates, Inc.; a subsidiary of Sika Corporation.
   b. Pecora Corporation.
   c. Sherwin-Williams Company (The).

d. Tremco Incorporated.

2.5 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adfast.
b. Alcot Plastics Ltd.
c. BASF Corporation.
d. Construction Foam Products; a division of Nomaco, Inc.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, water, and surface dirt.
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.

3. 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. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 CLEANING

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

3.5 PROTECTION

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

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Perimeter joints between interior wall surfaces and frames of interior doors and storefront system.
b. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by COTR from manufacturer's full range of colors.

B. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by COTR from manufacturer's full range of colors.

END OF SECTION 07 9200

SECTION 080351.23 - HISTORIC TREATMENT OF STEEL WINDOWS

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 historic treatment of steel windows in the form of the following:

1. Removing existing lock.
2. Installing lock.

1.3 DEFINITIONS

A. Window: Includes window frame, sash, hardware, and insect screens unless otherwise indicated by context.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for product application and use.

B. Samples for Initial Selection: For each type of exposed finish.

1. Include Samples of hardware and accessories involving color selection.

1.5 QUALITY ASSURANCE

A. Mockups: Prepare mockup of removal and installation of lock for aesthetic effects and to set quality standards for materials and execution.

1. Locate mockups on existing windows where directed by COTR.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless COTR specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Pack, deliver, and store products in suitable packs; surround with sufficient packing material to ensure that products will not be deformed, broken, or otherwise damaged.

B. Store products inside a well-ventilated area and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity, and where environmental conditions comply with manufacturer's requirements

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with historic treatment of steel windows only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 HARDWARE

A. Replacement Hardware: Replace existing or missing locking hardware with newly manufactured hardware.

1. As indicated on drawings.

B. Material and Design:

1. Material: Solid bronze of alloy indicated.
2. Replacement Window Hardware: Match existing window hardware of the following types:
   a. Window lock.

C. Hardware Finishes: Comply with BHMA A156.18 for base material and finish requirements indicated by the following:
1. BHMA 624: Dark-oxidized statuary bronze, clear-coated; bronze base metal.

2.2 MISCELLANEOUS MATERIALS

A. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

B. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.
1. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect adjacent materials from damage by historic treatment of steel windows.

B. Clean steel windows of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

3.2 CLEANING AND PROTECTION

A. Clean exposed surfaces immediately after historic treatment of steel windows. Avoid damage to coatings and finishes. Remove excess sealants, glazing and repair materials, dirt, and other substances.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 080351.23

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Interior hollow-metal doors and frames.

B. Related Requirements:

1. Section 08 7100 "Door Hardware" for door hardware for hollow-metal doors.

2. Division 26 “Electrical” for electrical wiring.

3. Division 28 “Electronic Safety and Security” for safety and security wiring.

1.3 DEFINITIONS

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

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.7 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.8 DELIVERY, STORAGE, AND HANDLING

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

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

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

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 102-mm- (4-inch-) high wood blocking. Provide minimum 6-mm (1/4-inch) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Baron Metal Industries Inc.; an Assa Abloy Group company.
2. Ceco Door; ASSA ABLOY.
3. Custom Metal Products.
4. DKS Steel Door & Frame Systems, Inc.
5. Steelcraft; an Allegion brand.

2.2 INTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Hollow-Metal Doors and Frames: NAAMM-HMMA 860; ANSI/SDI A250.4, Physical Performance Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 44.5 mm (1-3/4 inches).
   c. Face: steel sheet, minimum thickness of 1.0 mm (0.042 inch).
   d. Edge Construction: Continuously welded with no Projection or tack welded with visible seam.
   e. Core: Steel stiffened.
   f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated and temperature-rise-rated doors.

2. Frames:

   a. Materials: Uncoated steel sheet, minimum thickness of 1.3 mm (0.053 inch).
   b. Construction: Full profile welded.

3. Exposed Finish: Prime.

FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 610 mm (24 inches) of frame height above 2.1 m (7 feet).

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 51-mm (2-inch) height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 12G (04Z) coating designation; mill phosphatized.

2.4 MATERIALS

A. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

C. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

D. Glazing: Comply with requirements in Section 088000 "Glazing."

2.5 FABRICATION

A. Hollow-Metal Frames: Fabricate in one piece.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.
5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1.6 mm (1/16 inch), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1.6 mm (1/16 inch), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1.6 mm (1/16 inch), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1.6 mm (1/16 inch), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

3.3 FIELD QUALITY CONTROL

A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

C. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

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

END OF SECTION 08 1113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Flush Wood Doors for transparent finish
2. Factory finishing flush wood doors.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Dimensions and locations of mortises and holes for hardware.
7. Clearances and undercuts.
8. Requirements for veneer matching.
9. Doors to be factory finished and application requirements.

C. Samples for Initial Selection: For factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons, and wrap bundles of doors in plastic sheeting.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

B. Environmental Limitations: Do not deliver or install doors unless HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of veneer.
b. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flush wood doors single manufacturer.
B. 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. AJW
   2. Haley
   3. VT Industries.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings.

   1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

2.3 FLUSH WOOD DOORS GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Doors:

   1. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty.

   2. ANSI/WDMA I.S. 1A Grade: Custom.
   3. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.

      a. Species: Select white birch.
      b. Cut: Plain sliced (flat sliced).
      c. Match between Veneer Leaves: Book match.
      d. Assembly of Veneer Leaves on Door Faces: Balance match.

   4. Exposed Vertical Edges: Same species as face.

      a. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

1) Screw-Holding Capability: 550 lbf (2440 N) in accordance with WDMA T.M. 10.

5. Core for Non-Fire-Rated Doors:

a. ANSI A208.1, Grade LD-1 particleboard.

1) Blocking: Provide wood blocking in particleboard-core doors as follows:

a) 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
b) 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
c) 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

6. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as follows:

1) 5-inch (125-mm) top-rail blocking.
2) 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
3) 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
4) [4-1/2-by-10-inch (114-by-250-mm) lock blocks] [5-inch (125-mm) midrail blocking], in doors indicated to have exit devices.

7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Transparent Finish:

1. ANSI/WDMA I.S. 1A Grade: Custom.
2. Finish: Architectural Woodwork Standards System-5, Varnish, Conversion.
3. Finish: Architectural Woodwork Standards System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
4. Finish: Architectural Woodwork Standards System-10, UV Curable, Water Based.
5. Finish: Architectural Woodwork Standards System-11, Polyurethane, Catalyzed.
6. Finish: ANSI/WDMA I.S. 1A TR-4 Conversion Varnish.
7. Finish: ANSI/WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
8. Finish: ANSI/WDMA I.S. 1A TR-8 UV Cured Acrylated Polyester/Urethane
9. Staining: None required.
10. Effect: Open-grain finish
11. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

    a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

    a. Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors.
    b. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    c. Where threshold is shown or scheduled, provide1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
    d. Comply with NFPA 80 for fire-rated doors.

5. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
6. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 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. This Section includes the following:

1. Everything necessary for and incidental to the execution and completion of all door hardware work, as indicated on the drawings and specified herein.
2. Door hardware includes all items known commercially as "Builders' Hardware" required for swinging, sliding and bi-folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.

B. Related Sections include the following:

1. Section 081113 Hollow Metal Doors and Frames.
2. Section 081416 Flush Wood Doors.
3. Division 28 Sections for low-voltage wiring including provisions for electronic security system and for connections to building fire alarm system.

1.3 REFERENCES

A. The publications listed below, including the amendments, addenda and designated changes, form a part of this specification to the extent referenced.

1. Federal Specifications (FS): FF-H-111C-74 Hardware, Builders Shelf and Miscellaneous.
2. National Fire Protection Association (NFPA):

    a. Standard 70, National Electric Code.
    b. Standard 80, Fire Doors and Windows.
    c. Standard 101, Life Safety Code.
    d. Standard 105, Standard for Smoke Door Assemblies and Other Opening Protectives.
    e. Standard 252, Standard Methods of Fire Tests of Door Assemblies.

3. American National Standards Institute (ANSI):

    a. A156.6, Architectural Door Trim.
    b. A156.18, Materials and Finishes.

4. International Building Code (IBC): Basic Building Code.
5. Americans with Disabilities Act (ADA): Standards for Accessible Design.

6. Door and Hardware Institute (DHI):

    a. Keying Systems and Terminology.
    b. Abbreviations and Symbols.
    c. Recommended Locations for Builder's Hardware for Custom Steel Doors and Frames.

7. Underwriters Laboratories, Inc. (UL):

    a. UL-BMD, Building Materials Directory.
    b. UL 294, Standard for Safety Access Control System Units.

1.4 ACTION SUBMITTALS

A. Supplier's Hardware Schedule: Submit a door hardware schedule in accordance with Division 01 in the manner and format prescribed and used herein, complying with the actual construction progress. Hardware schedules are intended for coordination of the work. Review and acceptance by the Architect or Owner do not relieve the Contractor of his exclusive responsibility to fulfill the requirements as shown and specified.

1. Hardware Schedule Content: Based on hardware indicated, organize hardware schedule into groups or sets showing complete designations of every item required for each door opening. Schedule shall be vertical layout similar to the format used herein. Lines shall be double spaced with pages numbered and dated.

    a. For doors of different sizes or where hinges, locks or closers are different, a separate heading shall be used. No labeled openings shall be combined with non-labeled openings. Horizontal hardware schedules are not acceptable. Include the following:

        1) Number, location, hand, fire rating, size and material of each door opening (hands and swings to be determined in relation to key side of opening).
        2) Type, style, function, size, finish and quantity of each hardware item.
        3) Name and manufacturer of each item.
        4) Fastening requirements.
        5) Explanation of abbreviations used (use nomenclature consistent with DHI’s “Abbreviations and Symbols” wherever possible).
        6) Special mounting locations and instructions.

    b. Combined submittals are not acceptable. Do not combine hardware schedules with door and frame shop drawings.

2. Hardware Schedule Index: Furnish an index cross referencing Contract Document door number and hardware group, and supplier's hardware set.
3. Schedules not adhering to these parameters will not be reviewed.

B. Product Data:

1. Submit copies of manufacturers’ specifications, maintenance and keying manuals, and installation instructions for each item of door hardware.

2. Include photographs, catalog cuts, marked templates and other data as may be required to show compliance with these Specifications.

C. Samples: Submit full size hardware samples as requested.

1. These items shall remain on file in the Architect's office until all other similar items have been installed in the project. At that time, items on file will become Project Maintenance Stock.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Submit Hardware Suppliers' and Hardware Installers' qualifications verifying years of experience and hardware manufacturers' certifications; include list of completed projects having similar scope of work identified by name, location, date, reference names and phone numbers.

1. Furnish written proof of certification of all qualified installers and/or hardware installation firms/subcontractors responsible for installation of hardware specified.
2. Certifications of installers must be submitted for approval prior to the start of installation.

B. Templates: Provide necessary templates and/or physical hardware to all trades or factories requiring them so they may cut, reinforce or otherwise prepare their material or product to receive the hardware item. If any manufacturer requires physical hardware, ship to them such hardware via prepaid freight in sufficient time to prevent any delay in the execution of their work.

C. Other Informational Submittals: After Hardware Schedule has received approval; submit the following:

1. Keying Schedule: Detailed keying system schedule, indicating Owner's approved keying system, for Owner's review and approval. Include the following:

a. Schematic keying diagram
b. Index identifying each key set to unique door designations.
c. Bitting list.

2. Wiring Diagrams: Details of electrified door hardware. Include fire alarm and/or access control system interface where applicable.

a. Diagrams shall be complete by opening and shall indicate connections between all components affected. Manufacturers' standard line diagrams are not acceptable. Include the following:

1) System schematic.
2) Point-to-point wiring diagram.
3) Riser diagram.
4) Elevation of each door.

c. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

1.6 CLOSEOUT SUBMITTALS

A. Operating Instructions and Maintenance Data: Furnish one Compact Disk containing the Operation and Maintenance information. Coordinate delivery with the post-installation job site meeting. The disk shall be clearly labeled with the project name on the front. Include the following in clearly identified individual PDF files:

1. Maintenance instructions for each item of hardware supplied.
2. Copy of the final Door Hardware Schedules for all doors.
3. Current catalogs for each Hardware Manufacturer provided.
4. Names and phone numbers of the factory representatives for each item supplied.
5. Copy of the final Keying Schedule.
6. Copy of the final Wiring Diagrams.

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

C. Warranty: Special warranties specified in this Section.

1.7 QUALITY ASSURANCE

A. Contractor: Assign all door hardware installation activities to a qualified and experienced hardware Installer; who meets the following criteria:

1. An experienced Installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
2. Factory-certified training in the installation of Locksets, Exit Devices and Door Closers.
3. At least one certified Installer must be on site during installation for the purpose of guidance and inspection of all hardware installation, to ensure compliance to manufacturers' recommended installation procedures and bid specifications.
4. Installer shall arrange through Contractor to set up and attend pre-installation conference prior to installing door hardware. This conference shall cover mechanical and electrical hardware components including all locksets, door closers, and exit hardware.
5. All hardware shall be installed with factory provided fasteners using factory provided installation instructions & templates.

B. Supplier Qualifications: Recognized architectural door hardware supplier, with warehousing facilities in Project's vicinity, who has been furnishing hardware in the Project's vicinity for a period of not less than five years.

1. Supplier must employ an Architectural Hardware Consultant who shall be available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware.
2. Electrified Door Hardware Supplier Qualifications: An experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.

a. Engineering Responsibility: Prepare data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

3. Scheduling Responsibility: Preparation of door hardware and keying schedules.

C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

1. Electrified Door Hardware Consultant Qualifications: Experienced in providing consulting services for electrified door hardware installations.

D. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that are listed to perform electrical modifications, by a testing and inspecting agency acceptable to authorities having jurisdiction, are acceptable.

E. Accessibility for Disabled Persons: Special hardware requirements for knurling, slow acting closers or other barrier free opening requirements shall be provided as indicated in the Hardware Set Schedule and as required to comply with the U.S. Department of Justice's "ADA Standards for Accessible Design".

F. Hardware for Fire Doors and Exit Doors: Hardware for fire doors shall conform to NFPA 80; hardware for exit doors shall conform to NFPA 101. Other requirements specified shall also apply. Such hardware shall comply with the applicable UL standards for the intended use specified and be listed in UL BMD, or be labeled and listed by another testing laboratory deemed acceptable by the Authorities Having Jurisdiction (AHJ).

1. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to the AHJ, for fire ratings indicated, based on testing according to NFPA 252.

a. Test Pressure: After five minutes into the test, neutral pressure level in furnace shall be established at 40-inches or less above the sill.

G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the AHJ, and marked for intended use.

H. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01. In addition to the Contractor's Project Manager and Superintendent and the Owner, conference participants shall also include Hardware Subcontractor as well as any others requested by the Owner.

1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
c. Address for delivery of permanent keys and cores.

I. Pre-Installation Conference: Conduct conference at Project site. Review methods and procedures related to door hardware installation including, but not limited to, the following:

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

J. Installation Inspections: Periodic inspections of door hardware installations will be conducted by the Owner on a continuing on-site basis throughout the time periods of installation.

1. The Owner will provide feedback information relative to the acceptance or rejection of particular installations to all responsible parties.

K. Reference Standards: Except as otherwise required by governing authorities or Contract Documents, comply with applicable provisions of Door and Hardware Institute.

1.8 DELINEATION OF DOOR CONTROL INTERFACE RESPONSIBILITIES

A. Furnish and install electrified locking hardware, power transfers, magnetic door contacts, etc., as required for the system to perform the functions as defined herein.

B. Provide a single point of interconnection at the hinge or power transfer.

C. Provide a wiring interface for the project’s Security System Integrator to make connections to the control systems. The wiring interface shall be a Molex-Type connector. The mating connector to which the Security system conductors are connected shall be furnished as part of the connector assembly and shall be furnished with conductor "pigtail" having a minimum length of six inches.

D. Where required, furnish door hardware power supplies as required to power the specific equipment.

E. Provide solenoids for direct current (DC) application with diodes for transient protection.

F. Provide boxes or pockets in the door frame as required to accommodate magnetic door contacts, locks, power transfers, etc.; coordinate with door and frame manufacturers.

G. Provide interconnecting conduit in the door frame between all switches, monitoring devices, and electrified hardware.

1.9 PRODUCT DELIVERY

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

1. Deliver items of hardware at the proper times to the proper locations (shop or project site) in their original individual containers, complete with necessary appurtenances including screws, manufacturers' printed instructions, and where necessary, installation templates for manufacturer's suggested installation. Mark each individual container with the manufacturer's name and catalog number as they appear in the hardware schedule.

B. Representatives of the Contractor and the Hardware Supplier shall jointly inventory the door hardware. Replace items damaged in shipment promptly and with proper material without additional cost to the Contractor. Handle all hardware in a manner to eliminate marring, scratching or damage.

C. Keys:

1. Supply construction master keys to Contractor when cylinders are delivered, for use during construction.
2. Prior to the scheduled completion of the project, manufacturer shall ship all permanent keys directly to the Owner via Registered Mail, Return Receipt Requested or other pre-approved means.
3. Under no circumstance shall any permanent keys be furnished direct to the Contractor.

1.10 WARRANTIES

A. Warranties shall be furnished in accordance with Division 01.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of operators and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Minimum Warranty Periods:

a. Hinges: Life of the installation.
b. Manual Closers: Twenty-five years from date of Substantial Completion.
c. Continuous Hinges: Ten years from date of Substantial Completion.
d. Exit Devices and Locksets:

1) Mechanical: Five years from date of Substantial Completion
2) Electrified: Two years from date of Substantial Completion.

e. All other hardware items: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Template Hardware: Hardware to be applied to metal or pre-finished doors and frames shall be made to template. Coordinate hardware locations to prevent interference with other hardware items.

B. Identification: All hardware items shall be clearly and permanently marked by the manufacturer where it will be visible after installation.

2.2 HARDWARE ITEMS

A. Butt Hinges: Hager Companies, Ives, McKinney Products Company or Stanley Works.

1. Hager BB1279 Series, Ives 5BB1 Series, McKinney TB2714 Series or Stanley FBB179 Series.
2. Furnish two butt hinges for doors 1525 mm (60-inches) or less in height and one additional butt hinge for each additional 760 mm (30-inches) of height or fraction thereof. Unless otherwise specified, butt hinges for doors through 915 mm (36-inches) wide shall be 4.5 x 4.5; butt hinges for doors over 1015 mm (40-inches) wide shall be heavy-weight 5 x 4.5.
3. All butt hinges shall have five knuckles. Furnish non-removable pins (NRP) for all reverse bevel doors receiving keyed locks, rigid outside trim or exit only hardware. Provide butt hinges with holes in the bottom plug to facilitate pin removal.
4. Butt hinges for labeled doors shall comply with the requirements of NFPA 80.

B. Continuous Hinges: PBB, Inc., Select Products Limited or Zero International.

1. Geared-Type: Extruded aluminum leaves with interlocking cover and nylon bearings.

a. Continuous geared hinges shall consist of two full height bearing levers, geared together for the full length of the hinge and joined with a cover channel.
b. Continuous geared hinges are to be heavy duty type with a minimum of 32 bearings up to 2130 mm (84-inches) in height. Bearings are to be completely concealed in a full cover channel.

C. Cylinders: Yale Security, Inc.

1. Provide scheduled products. The products scheduled shall be used to the exclusion of all others and no other products will be considered to be equal.
2. Description:

a. Cylinders shall have a minimum of six pins.
b. Cylinder parts manufactured from brass, bronze, stainless steel, or nickel silver.
c. All cylinders shall be construction master keyed. Provide manufacturer’s special pin tumbler cylinders that permit voiding construction keys without removal of the cylinder.
d. Include all necessary extensions, cams, tail pieces and hardened collars required for a complete installation.

D. Locks and Latches: Schlage Lock Company or Yale Security, Inc.

1. Locks and latches shall be equal to Yale 8800 Series with CRR Trim.

    a. For each lock and latchset, provide wrought strike box and square corner ASA strikes with curved lips of sufficient length to protect frames; at pairs of doors furnish flat lip strikes.
    b. Furnish knurling to lever on corridor side of door to all doors leading to hazardous areas (e.g. Mechanical Rooms, Electrical Rooms, Elevator Machine Rooms, etc.).

2. All internal working parts shall be brass, bronze, steel or stainless steel.
3. Furnish keyed devices with cylinders keyed to building system.
4. Electrical Modifications:

    a. Locks specified to be electrified shall be modified to Electrically Lock (FS) or Electrically Unlock (FSE), as indicated, upon receipt of a 24V signal and will remain in this mode until signal is interrupted.
    b. Locks indicated to have “Request-To-Exit” switches shall incorporate internal SPDT contacts for remote signaling of operation of the inside lever handle. Switches shall be used in conjunction with the Electronic Security Control System to accommodate "authorized egress".
    c. Field-connect electrified locksets to associated power transfer units. Coordinate electrical connection and installation with Division 28.

E. Exit Devices and Accessories: Precision Hardware, Inc., Von Duprin, Inc. or Yale Security, Inc.

1. Refer to the Hardware Set Schedule for grade and function.

    a. Where lever handle functions are required on exit devices, they shall match the design and construction of lever handles specified for mortise locks.

2. Furnish with provision for concealed mounting, through bolts will not be acceptable.
3. Furnish keyed devices with cylinders keyed to building system.
4. Provide UL-labeled fire-exit hardware at fire-rated openings.

F. Surface Closers: dormakaba, LCN Closers or Sargent Manufacturing Company.

1. Surface closers shall be dormakaba 8900 Series, LCN 4010 Series or Sargent 281 Series.
2. Closer arms shall be forged and fluid shall accommodate all applicable weather conditions.

    a. At parallel arm installations, provide manufacturer’s heaviest-duty arm assembly.

3. Where factory sized closers are specified, sizes are to be determined by manufacturer's recommendations for door size, location and applicable handicap requirements.

    a. Door opening forces shall comply with ADA Standards 309.4 and 404.2.9.

4. Install surface closers on the least conspicuous side of the door (side opposite public view).

    a. Where required to avoid interference with acoustical seals, provide closer mounting brackets for proper frame attachment. Field-paint brackets to match frame finish.

5. Provide surface closers complete with accessory items and attachments, including full closer covers, special arms, soffit shoes, and drop plates. Corner bracket installations are not acceptable.

    a. Closers, covers, brackets and other components shall not extend below bottom of top horizontal rail of door.

G. Architectural Door Trim: Hager Companies, Ives, Rockwood Manufacturing Company or Triangle Brass Manufacturing Company, Inc.

1. Protection Plates: Beveled on all sides, equal to Hager 190S Series.

    a. Unless otherwise indicated, or where narrow bottom rails dictate a smaller size, kick plates shall be 200 mm (8-inches) high and armor plates 860 mm (34-inches high). Width shall be 38 mm (1-1/2-inches) less than the door width on single doors and 25 mm (1-inch_ less than the door width on double doors.
    b. Armor plates on labeled doors shall comply with the requirements of NFPA 80.

2. Fasteners: Furnish all flat goods with Phillips undercut, countersunk screws per ANSI A156.6. Trusshead screws are not acceptable.

H. Auxiliary Hardware: Hager Companies, Ives, Rockwood Manufacturing Company or Triangle Brass Manufacturing Company, Inc.

1. Manual Flush Bolts: Top manual flush bolts shall not exceed 1880 mm (74-inches) from floor to centerline.
2. Provide wall stops equal to Rockwood #400 wherever door strikes wall. Where wall stops are not suitable, furnish floor stops equal to Rockwood #446.
3. Silencers: Provide rubber silencers equal to Rockwood #608 for hollow metal frames. Furnish three per single door and four per pair.

    a. Silencers are not required at doors specified to receive continuous seals or weather-stripping.

I. Overhead Holders and Stops: Architectural Builders Hardware, Glynn-Johnson, Rixson or Rockwood Manufacturing Company.

1. Where floor stops will not work, furnish concealed overhead stops equal to Rockwood #OH200S.

J. Seals and Door Bottoms: National Guard Products, Inc., Reese Enterprises, Inc. or Zero International.

1. Provide smoke, light, or sound gasketing on doors where indicated or scheduled.
2. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated.

    a. Smoke Seals: At all fire-rated wood doors, all 20-minute rated doors, and any other doors required to be ‘smoke resistant’, provide the following:

1) Head and Jambs: Smoke seals equal to Pemko #S88BL.
2) Meeting Stile at Pairs: Overlapping astragal seals equal Pemko #772BL or two Pemko #303AS as appropriate for intended hardware operation.
3) Refer to the Drawings for locations.

4. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

K. Electric Strikes: Folger Adam Company, H.E.S. or Von Duprin, Inc.

1. Units shall operate at 24VDC current; refer to the Hardware Set Schedule for grade and function.
2. Field-connect electric strikes to associated power transfer units.
3. Products must be UL 294 Listed.
4. Coordinate electrical connection and installation with the Divisions 26 and 28.

L. Magnetic Door Contacts:

1. Magnetic door contacts are furnished by the Security System Integrator. Include templates for products so doors and frames are properly factory-machined to receive material without field-modification.
2. Coordinate electrical connection and installation with Division 28.

M. Special Tools: Provide any necessary special tools (e.g. spanner and socket wrenches, dogging keys, etc.) required to service and adjust hardware items.

2.3 HARDWARE FINISHES

A. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturers standard metal alloy composition, temper and hardness, but in no case of lesser quality than specified or inferred by use of a particular manufacturer's number, style or grade or as established by appropriate referenced specification listed herein.

B. Finishes: Finishes shall conform to the quality of finish including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case less than the standards established by ANSI/BHMA A156.18 or Federal Specifications FF-H-111C as applicable.

1. Unless otherwise indicated, all exposed hardware except surface closers shall be polished stainless steel, ANSI/BHMA 629/US32.

a. Surface closers shall be factory-finished to match polished stainless steel.
b. Items of hardware not available in stainless steel shall be furnished polished chrome plated, ANSI/BHMA 625/US26.

2. Where painting of primed surfaces is required, refer to Division 09 specifications.

2.4 KEYING

A. General: Key system shall be as directed by the Owner.

1. Key System: Provide the type of system required (e.g. master, grand master, great grand master); nomenclature and layout to be consistent with DHI "Keying Systems and Terminology".

a. Keying is the responsibility of the Contractor; and shall be performed by the Cylinder Manufacturer.
b. All cylinders shall be keyed to the existing Yale Security, Inc. master key system.

2. Key System Summary, Cover Sheet, and Letter of Authorization shall accompany Keying Schedule and Purchase Order sent to Factory.

B. Keys: Provide ten construction keys for use during construction.

2.5 FASTENERS

A. Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping or sheet metal screws except as specifically indicated.

1. Furnish screws for installation with each hardware item. Provide Phillips flat head or oval head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces of other work, to match the finish of such work as closely as possible, except as otherwise indicated.

a. Where wood screws are required, they shall be full thread (to the head) type. Combination wood/machine screws, in lieu of wood screws, are not acceptable.

2. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard manufactured units of the type specified are available with concealed fasteners. Do 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 avoid the use of through bolts.
3. Furnish fasteners which are compatible with both the unit fastened and the substrate, and which will not cause corrosion or deterioration of hardware, base material reinforcement or fastener. Furnish wall stops with "Toggle" anchors and wood screws. Furnish thresholds and floor stops with lead anchors and 1/4-20 stainless steel machine screws.

PART 3 - EXECUTION

3.1 STORAGE AND HANDLING

A. Representatives of the Contractor and the Hardware Supplier shall jointly inventory the door hardware. Replace items damaged in shipment promptly and with proper material without additional cost to the Contractor. Handle all hardware in a manner to eliminate marring, scratching or damage.

1. A dry, locked storage space complete with adequate shelving shall be set aside for the purpose of unpacking, sorting out, checking and storage. Control the handling and installation of hardware items, whether immediately replaceable or not, so completion of the work will not be delayed by losses before or after installation.
2. Tag each item or package separately, with identification related to the final approved hardware schedule, and include basic installation instructions in the package. Furnish hardware items of proper design for use on doors and frames of thickness, profile, swing, security and similar requirements indicated as necessary for proper installation and function.

3.2 COORDINATION

A. Coordinate Door Hardware Schedule submission and hardware ordering to insure delivery of all items as directed by the Contractor.

1. Prior to ordering any hardware, examine the shop drawings and details of doors and frames and other substrate suppliers to determine that the proper type and size pieces of hardware are being furnished. No extra for material or labor will be allowed for any corrections that should have been eliminated by proper prior coordination.

B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, and access control system.

1. Coordinate installation of the electronic security hardware with the Architect and Electrical Engineers and provide installation and technical data to the Installer and other related sub-contractors.

D. Concrete formwork requirements are specified in Division 03.

E. Coordination with Adjacent Finishes:

1. If cutting and fitting are required to install hardware onto or into surfaces that are later painted or finished in another way, install each item completely and then remove and store in secure place during finish application.
2. After completion of finishes, reinstall each item.
3. Do not install surface mounted items until finishes are complete on substrate.

3.3 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 INSTALLATION

A. Install each hardware item in accordance with final approved Hardware Schedule and manufacturer's instructions.

1. Set hardware level, plumb and true to line and location.
2. Adjust and reinforce attachment substrate as required for proper installation and operation of hardware.
3. Drill and countersink units which are not factory-prepared for anchorage fasteners; space fasteners and anchors uniformly, in accordance with industry standards.

B. Hardware Mounting Heights:

1. Provide heights as indicated on Drawings, except as otherwise required for compliance with governing regulations.
2. Where heights are not indicated, comply with mounting requirements of DHI "Recommended Locations for Builder's Hardware" on custom steel doors and frames.

C. Fire Doors and Exit Doors:

1. Hardware for labeled fire doors shall be installed in accordance with the requirements of NFPA 80.
2. Hardware for listed exit doors shall be installed in accordance with the requirements of NFPA 101.

D. Hinges:

1. Install steel doors and wood doors to comply with reference standards, as specified in door sections.
2. Where shimming is required to comply with tolerances, provide metal shims only.

E. Electrified Hardware:

1. Pre-wire and make field connections between all electrically operated and monitored hardware items including, but not limited to, locks, exit devices, power transfers and magnetic door contacts.
2. All wiring must be 18-gauge or thicker.

F. Closers:

1. Do not install parallel arm closers until after gasketing or seals have been installed on head frame (where weather-stripping or seals are scheduled).
2. Adjust closers to control door swing and to provide positive latching of doors.

    a. Adjust closers not to exceed following manual opening forces:

1) Exterior doors: As required to close and latch each leaf.
2) Interior doors (non-fire-rated): Maximum 5-pound opening force.
3) Fire-rated doors: As required to close and latch each leaf.

b. After air-handling system has been balanced, make final adjustment of all closers.

G. Door Stops:

1. Install stops for maximum degree of door opening swing allowed by conditions of installation.
2. Locate floor stops so as not to create a tripping hazard.

H. Gasketing and Seals:

1. Install continuous around door heads and jambs, and meeting stiles of pairs of doors.
2. Install bottom sweeps and automatic door bottoms for full width of door.
3. Do not cut gasketing or seals for attachment of closer brackets or shoes.
4. Installation of adhesive gasketing and seals: The following installation instructions must be strictly adhered to. Failure to comply can result in premature product failure. Contractor will be required to remove failed product entirely and properly install new materials.

a. Before installation, thoroughly clean the frame with the manufacturer-enclosed cleansing towelette to remove grease, dust or cleanser build-up. Before installation, wait for frame surface to completely dry (evaporate). As an alternative or substitute cleanser, use isopropyl (rubbing) alcohol. Mineral spirits or other petroleum-based cleaning products should NOT be used.
b. Application Temperature: Do not install if frames are below 50ºF or above 100ºF.
c. When to Install:

1) Installation should take place after construction is completed, flooring is installed and final cleaning is completed.
2) Paint on frame must be cured for at least 5-7 days. Paint cannot be wet under dry surface when gaskets are pressed on. Avoid quick-dry primers, which leave a powdery surface preventing sufficient adhesion.
3) When applying to a wood frame, the surface must be non-porous and sealed. Follow standard industry guidelines on sealed wood frames and/or rough surface before applying.

5. Gasketing and seals must form an airtight barrier around the full perimeter of the door. There can be no gaps that allow air, light, sound, or smoke to pass through.

a. Contractor is responsible for adjusting the alignment of doors and seals until the above conditions are met. If gaps cannot be avoided because the door or frame is not properly sized, plumb, and level, the offending components must be replaced at contractor expense.

3.5 ADJUST AND CLEAN

A. General: To insure proper operation and function of every unit, adjust and check each operating item of hardware and each door. Lubricate moving parts with type lubrication recommended by

the manufacturer (graphite-type if no other recommended). Replace unit that cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.

B. Continuity Testing: Inspect all connections between electrically operated and monitored hardware items including, but not limited to, locks, exit devices, power transfers and magnetic door contacts. Upon completion of inspection, furnish the Owner with itemized report indicating any problems found and steps taken to repair anomalies.

C. Final Adjustment: Wherever hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, to perform a final check and adjustment of all hardware items in such space or area. Clean and re-lubricate as necessary to restore proper function and finish of hardware and doors.

1. Prior to acceptance of any electrical hardware system, an operational test shall be performed to determine if devices are functioning as intended by the specifications. Wiring shall be tested for correct voltage, current-carrying capacity, and proper grounding. Stray voltages in lock wiring shall be eliminated to prevent locking devices from releasing in critical situations.

3.6 HARDWARE SET SCHEDULE

A. Description of Work:

1. The following set schedule is to be used with Drawings as a guide for furnishing door hardware.
2. Set numbers specified correspond to set numbers indicated on Drawings.
3. Schedules do not reflect hand, backset (except as noted) or method of fastening of hardware items.

Set 115

	Hinges BB1279	Hager
1	Passage function latchset 8801FL	Yale
1	Surface closer 4111	LCN
1	Stop	Rockwood

Set 303

	Remove conflicting existing devices and install:	
1 set	Exit device trim 996L-NL x 03 (rim device)	Von Duprin
1	Cylinder	Yale
1	Surface closer 4111	LCN
1	Kick plate 190S	Hager
1	Electric strike 6211 - FSE	Von Duprin
1	Magnetic door contact	Security System Integrator
1	Card reader	Security System Integrator
1	Motion sensor	Security System Integrator
1	Power supply	Security System Integrator
3	Silencers 608	Rockwood
	Balance of existing hardware to remain	

Function: Card reader shunts door contact and releases electric strike. Motion sensor shunts door contact. Door position status monitored through Access Control System.

Set 510

	Hinges BB1279	Hager
1	Office function lockset 8809FL	Yale
1 set	Sound seals 8145S-Bk – Head & Jambs	Zero
1	Automatic door bottom 369AA	Zero
1	Stop	Rockwood

Set 712

	Hinges BB1279	Hager
1	Classroom function lockset 8808FL	Yale
1	Surface closer 4011 / 4111	LCN
1	Kick plate 194S	Hager
1	Stop	Rockwood

Set 810

	Hinges BB1279	Hager
1	Storeroom function lockset 8805FL	Yale
1 set	Sound seals 8145S-Bk – Head & Jambs	Zero
1	Automatic door bottom 3551A	Zero
1	Stop	Rockwood

Set 814

1	Continuous hinge SL24 HD x dutch door cut	Select
1	Storeroom function lockset 8805FL	Yale
1	Dutch door bolt 054	Ives
1	Surface closer 4011-H	LCN
1	Electric strike 6211 - FSE	Von Duprin
2	Magnetic door contacts	Security System Integrator
1	Motion sensor	Security System Integrator
1	Card reader	Security System Integrator
1	Power supply	Security System Integrator
2	Stops	Rockwood

Function: Card reader shunts door contacts and releases electric strike. Motion sensor shunts door contacts. Door position status monitored through Access Control System.

Set 815

	Hinges BB1279	Hager
1	Storeroom function lockset 8805FL	Yale
1	Surface closer 4011	LCN
1	Electric strike 6211 - FSE	Von Duprin
1	Magnetic door contact	Security System Integrator
1	Motion sensor	Security System Integrator
1	Card reader	Security System Integrator
1	Power supply	Security System Integrator
1	Stop	Rockwood

Function: Card reader shunts door contact and releases electric strike. Motion sensor shunts door contact. Door position status monitored through Access Control System.

Set 820

	Hinges BB1279	Hager
1	Storeroom function lockset 8805FL	Yale
2	Flush bolts 555	Rockwood
1	Dust strike 570	Rockwood
2	Kick plates 190S	Hager
2	Stops	Rockwood
	Astragal by door manufacturer	

END OF SECTION 087100

SECTION 087111 - 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 Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.

1.3 COORDINATION

A. 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.

B. Security: Coordinate installation of door hardware, keying, and access control with COR.

C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

a. Flow of traffic and degree of security required.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For mounting location of door hardware.

C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.

1. Tag Samples with full product description to coordinate Samples with door hardware schedule.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For each type of exposed product, in each finish specified.

1. Sample Size: Full-size units.

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. Tag Samples with full product description to coordinate Samples with door hardware schedule.

F. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule 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.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Fastenings and other installation information.
e. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
f. List of related door devices specified in other Sections for each door and frame.

G. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Architectural Hardware Consultant.

B. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, and COR about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to COR.

D. Deliver keys and permanent cores to COR by registered mail or overnight package service.

1.9 WARRANTY

A. Special Warranty: 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 below:

a. Exit Devices: Two years from date of Substantial Completion.
b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of door hardware from single manufacturer.

B. 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. Assa Abloy
2. Allegion

2.2 PERFORMANCE REQUIREMENTS

A. Means of Egress Doors: Latches do not require more than 15 lbf (.00068 tf)to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the ABA standards of the Federal agency having jurisdiction.

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 (.0023 tf)
2. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (.0023 tf) applied perpendicular to door.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than ½" (12 mm) high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 HINGES

A. Antifriction-Bearing Hinges:

1. Mounting: Full mortise (butts).
2. Bearing Material: Ball bearing.
3. Grade 1 (heavy weight).
4. Base and Pin Metal: Stainless steel with stainless steel pin.
5. Pins: Nonremovable.
6. Tips: Flat button.
7. Corners: Square.
8. Features: Safety stud.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Mortise Locks: Minimum 3/4-inch (19 mm) latchbolt throw.
2. Deadbolts: Minimum 1.25-inch (32 mm) bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description: Full Face.
2. Levers: Cast.

a. Construction: Solid.

3. Escutcheons (Roses): Cast.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

G. Manufacturers:

1. Yale.

H. Push-Pull Latches: Mortise, BHMA A156.13; with paddle handles that retract latchbolt; capable of being mounted vertically or horizontally.

1. Manufacturers:

a. Yale

2. Grade 1.
3. Lever and Escutcheon Material: Stainless steel.

2.5 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

1. Manufacturers:

a. Yale

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.
2. Number of Pins: Seven.
3. Lock Type: Mortise type.

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.6 KEYING

1. Existing System:

a. Master key or grand master key locks to Owner's existing Yale system.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE."

2.7 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel.

2.8 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with

manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.9 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; brass base metal.

B. Manual Combination Stop and Holder: Grade 1; 3-1/2 inches long, with holder, keeper, and rubber bumper.

1. Installation: Surface-screw or Expansion-shield installation.

C. Wall Bumpers: Grade 1; with rubber bumper; 2-1/2-inch diameter, minimum 3/4-inch projection from wall; with backplate for concealed fastener installation.

1. Bumper Configuration: Convex.

D. Location: Manual Combination Stop and Holder at all locations unless where not possible, provide Wall Bumper.

2.10 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg, as follows:

1. Gasketing on single door: 0.3 cfm/sq. ft. of door opening.

C. Adjustable, Housed, Perimeter Gasketing: Screw-adjustable, polyurethane bulb gasket material held in place by housing; fastened to frame stop with screws.

1. Housing Material: Aluminum.

D. Door Shoes: Neoprene gasket material held in place by housing; mounted to bottom edge of door with screws.

1. Housing Material: Aluminum.
2. Extended Housing: One side of door.
3. Mounting: Surface mounted on bottom edge of door.

2.11 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

B. Saddle Thresholds:

1. Type: Applied gasketed stop and fluted top.
2. Base Metal: Aluminum or Stainless steel.

2.12 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

B. Mop Plates: 8” (203 mm) high by door width with allowance for frame stops.

C. Location: At all doors front and back.

2.13 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

B. Silencers for Metal Door Frames: Grade 1; neoprene or rubber; minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

2.14 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by COTR.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

a. Machine Screws: For the following:

1) Hinges mortised to doors or frames.
2) Strike plates to frames.

3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:

1) Surface hinges to doors.
2) Closers to doors and frames.
3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15 FINISHES

A. Provide finishes 626, 628 or 630 complying with BHMA A156.18 that matches existing door hardware finish.

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

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by COR.
2. Furnish permanent cores to COR for installation.

E. Key Control System:

1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
2. Key Lock Boxes: Install where indicated or approved by COR to provide controlled access for fire and medical emergency personnel.
3. Key Control System Software: Set up multiple-index system based on final keying schedule.

F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

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

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 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.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Glass for HM doors.
2. Glass for wood doors.
3. Glazing sealants and accessories.

B. Related Requirements:

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 C1036.

C. IBC: International Building Code.

1.4 COORDINATION

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

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 4.4 deg C (40 deg F).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Cardinal Glass Industries.
2. Guardian Glass; SunGuard.
3. Pilkington North America.
4. Viracon, Inc.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain airtight; deterioration of glazing materials; or other defects in construction.

B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Glazing Manual."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

D. Strength: Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 GLAZING SEALANTS

A. General:

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

2.6 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 C1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.7 MISCELLANEOUS GLAZING MATERIALS

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

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

C. Setting Blocks:

1. Type recommended by all-glass storefront and glass manufacturer.

D. Spacers:

1. Type recommended by all-glass storefront and glass manufacturer.

E. Edge Blocks:

1. Type recommended by all-glass storefront and glass manufacturer.

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. Minimum required face and edge clearances.
3. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

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

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide 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.

G. 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.

H. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 8000

SECTION 09 2900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 09 2216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 300-mm- (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 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 C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

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

2.2 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. Gypsum Board, Type X: ASTM C1396/C1396M.

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. American Gypsum.
    b. CertainTeed Gypsum
    c. National Gypsum Company.
    d. USG Corporation.

2. Thickness: 15.9 mm (5/8 inch).
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Gypsum Ceiling Board: ASTM C1396/C1396M.

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. American Gypsum.
    b. CertainTeed Gypsum.
    c. National Gypsum Company.

d. USG Corporation.

2. Thickness: 12.7 mm (1/2 inch).
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. L-Bead: L-shaped; exposed long flange receives joint compound.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, 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 compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.84 to 2.84 mm (0.033 to 0.112 inch) thick.

C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

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

a. Hilti, Inc.
b. Pecora Corporation.
c. USG Corporation.

2. Verify sealant has a VOC content of 250 g/L or less.
3. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1.5 mm (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. 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 0.7 sq. m (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 6.4- to 9.5-mm- (1/4- to 3/8-inch-) wide joints to install sealant.

F. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 6.4- to 12.7-mm- (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.

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

H. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: Vertical surfaces unless otherwise indicated.
2. Type X or Type C: Where required for fire-resistance-rated assembly.
3. Ceiling Type: Ceiling surfaces.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

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. 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.

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, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

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

END OF SECTION 09 2900

SECTION 09 5123 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Acoustical tiles for interior ceilings.
2. Fully concealed, direct-hung, suspension systems.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 150 mm (6 inches) in size.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Tiles: Set of full-size Samples of each type, color, pattern, and texture.
2. Concealed Suspension-System Members: 150-mm- (6-inch-) long Sample of each type.
3. Exposed Moldings and Trim: Set of 150-mm- (6-inch-) long Samples of each type and color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each acoustical tile ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Evaluation Reports: For each acoustical tile ceiling suspension system and anchor and fastener type, from ICC-ES.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size tiles equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations:

1. Suspended Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile and its suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL TILES ACT-1

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong World Industries
2. USG Corporation
3. Certainteed Ceilings

B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Basis of Design:
1. Armstrong Optima Lay-In and Tegular: 3251
2. Armstrong Optima Lay-In and Tegular: 3252 .

D. Texture: Provide tiles as follows:
1. Texture: Fine.

E. Color: White.

F. Light Reflectance (LR): Not less than 0.88.

G. Articulation Class (AC): Not less than 190.

H. Noise Reduction Coefficient (NRC): Not less than 0.95.

I. Edge/Joint Detail: Square Tegular.

J. Thickness: 1” (25mm).

K. Modular Size: 610 by 610 mm (24 by 24 inches).

2.4 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong World Industries
2. USG Corporation
3. Certainteed Ceilings

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C635/C635M.
1. Face Dimension: 9/16” (14 mm)
2. Color: White
3. Duty Rating: Heavy Duty
4. Materials: Hot-dipped Galvanized Steel

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

    a. Type: Postinstalled bonded anchors.
    b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 2.69-mm- (0.106-inch-) diameter wire.

2.6 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles 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 panel to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL PANEL CEILINGS

A. Install suspended acoustical tile ceilings according to ASTM C636/C636M and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Space hangers not more than 1200 mm (48 inches) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 200 mm (8 inches) from ends of each member.
8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

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 400 mm (16 inches) o.c. and not more than 75 mm (3 inches) from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.

1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 305 mm (12 inches) o.c.
3. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 3 mm in 3.6 m (1/8 inch in 12 feet), non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 3 mm in 3.6 m (1/8 inch in 12 feet), non-cumulative.

3.5 ADJUSTING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5123

SECTION 09 6513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Thermoplastic-rubber base.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, not less than 300 mm (12 inches) long.

C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 300 mm (12 inches) long.

D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

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. Furnish not less than 3 linear m (10 linear feet) for every 150 linear m (500 linear feet) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 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 10 deg C (50 deg F) or more than 32 deg C (90 deg F).

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 21 deg C (70 deg F) or more than 35 deg C (95 deg F), in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 13 deg C (55 deg F) or more than 35 deg C (95 deg F).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. Johnsonite; a Tarkett company.
3. Nora Systems, Inc.
4. Roppe Corporation, USA.

B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).

1. Basis of Design: Nora Wall Base Art. 820
2. Group: I (solid, homogeneous).
3. Style and Location:

a. Style B, Cove: Provide in areas indicated.

C. Thickness: 3.2 mm (0.125 inch).

D. Height: 102 mm (4 inches).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed or preformed.

G. Inside Corners: Job formed or preformed.

H. Colors: Match COTR's sample.

2.2 RUBBER MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. Johnsonite; a Tarkett company.
3. Nora Systems, Inc.
4. Roppe Corporation, USA.

B. Description: Reducer Strip and Floor Transition Strip

C. Location: At doors where there is a change of floor finish material between existing or new work.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. Preformed Corners: Install preformed corners before installing straight pieces.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 76 mm (3 inches) in length.

a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 76 mm (3 inches) in length.

a. Miter or cope corners to minimize open joints.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal 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 subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 6513

SECTION 09 6519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rubber floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: Full-size units of each color, texture, and pattern of floor tile required.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces, with ambient temperatures maintained within range recommended by manufacturer, but not less than 10 deg C (50 deg F) or more than 32 deg C (90 deg F). Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 21 deg C (70 deg F) or more than 35 deg C (95 deg F), in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 13 deg C (55 deg F) or more than 35 deg C (95 deg F).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM 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.

2.2 RUBBER FLOOR TILE

A. Subject to compliance with requirements, provide Nora by Interface, Norament Satura Tiles; or an approved equal that meets all of the technical, performance, and aesthetic characteristics of the following product:

B. Thickness: 1/(8” (3.5 mm)

C. Size: 40” (1004 mm) by 40” (1004 mm).

D. Installation Method: Glue Down.

E. Colors and Patterns: As selected by COTR from manufacturers standard colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

1. Verify adhesives have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
    a. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

END OF SECTION 09 6519

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Modular carpet tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

C. Samples for Initial Selection: For each type of carpet tile.

1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

F. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.8 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.9 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

3. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Subject to compliance with requirements, provide J+J Flooring Tempo Modular; or an approved equal that meets all of the technical, performance, and aesthetic characteristics of the following product:

B. Construction: Textured Pattern Loop

C. Backing: Manufacturer’s standard

D. Color & Pattern: To be selected from Manufacturer’s color & pattern

E. Dye Method: Solution Dyed

F. Fiber Type: Nylon.

G. Face Weight: 16 oz./sq. yd. (542 g/sq. m).

H. Pile Density: 5071 oz./cu. yd. (206297 g/cu. m)

I. Size: 24 in x 24 in (610 mm x 610 mm).

J. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer’s Standard.

K. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

L. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 096933 - LOW-PROFILE FIXED HEIGHT ACCESS 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 low-profile, fixed-height access flooring.

1.3 COORDINATION

A. Coordinate location of electrical work in underfloor cavity and wire management channels.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review connections between low-profile, fixed-height access flooring and electrical systems.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for low-profile, fixed-height access flooring.
2. Include loading capacities.

B. Shop Drawings: For low-profile, fixed-height access flooring:

1. Include layout of low-profile, fixed-height access flooring and relationship to adjoining Work based on field-verified dimensions.
2. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.

C. Samples:

1. Exposed Metal Accessories: Approximately 10 inches (250 mm) in length.
2. One full-size unit for each component of each type of low-profile, fixed-height access flooring required.
3. Floor Coverings: Full-size units for each color and texture specified.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1. Low-Profile, Fixed-Height Access-Flooring Components: One of each type.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical low-profile, fixed-height access flooring. Size to be an area of no fewer than three floor panels in length by three floor panels in width.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Low-profile, fixed-height access flooring shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7**.

B. Structural Performance:

1. Loading Capacity: **250-lbf/sq. ft. (12.0-kN/sq. m)** live load with the following deflection and permanent set:

a. Top-Surface Deflection: Maximum **0.15 inch (0.38 mm)**.
b. Permanent Set: Maximum **0.06 inch (0.15 mm)**.

C. Fire Performance:

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2.2 LOW-PROFILE, FIXED-HEIGHT ACCESS FLOORING WITH MODULAR WIRING If retaining more than one panel type, indicate location of each on Drawings and insert drawing

designation. Use these designations on Drawings to identify each product. Manufacturers listed in this article include factory-assembled wiring harnesses as an integral part of their product.

A. Low-Profile, Fixed-Height Access Flooring with Modular Wiring: Manufacturer's reinforced, modular, steel or polymer components, designed to interconnect and provide channels for installation of wiring. Include factory-assembled modular wiring harnesses and service outlets; with manufacturer's standard factory-applied finish.

1. Basis of Design: FreeAxez Gridd 40.
2. Height: Provide low-profile access flooring with nominal height of **1-1/2 inches (38 mm)**.

B. Service Outlets and Wiring: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels; for power, communication, and signal services; and complying with the following requirements:

1. Structural Performance: Cover capable of supporting a **1000-lbf (4448-N)** concentrated load.
2. Receptacles and Wiring: Electrical receptacles and wiring for service outlets are specified elsewhere.

C. Fascia Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal closure plates with manufacturer's standard finish.

D. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, of same materials, performance, and construction requirements as low-profile, fixed-height access flooring.

E. Perimeter Support: Provide manufacturer's standard method for supporting panel edge and forming transition between low-profile, fixed-height access flooring and adjoining floor coverings at same level as low-profile, fixed-height access flooring.

2.3 FABRICATION

A. Fabrication Tolerances:

1. Size: Plus or minus 0.020 inch (0.50 mm) of required size.
2. Flatness: Plus or minus 0.035 inch (0.89 mm), measured on a diagonal on top of panel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer and manufacturer's authorized representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of conditions and deleterious substances that might interfere with attachment of pedestals.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

B. Lay out low-profile access flooring installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches (152 mm).

C. Complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

3.3 INSTALLATION

A. Install low-profile, fixed-height access flooring and accessories under supervision of low-profile, fixed-height access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.

B. Install flooring securely in place and properly seated, with panel edges flush. Do not force panels into place.

C. Scribe perimeter panels to provide a close fit with adjoining construction, having no voids greater than 1/8 inch (3 mm) where panels abut vertical surfaces.

END OF SECTION 096933

SECTION 09 9123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

B. Related Requirements:

1. Section 09 2900 “Gypsum Board” for gypsum board wall & ceiling.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

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, 200 mm (8 inches) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 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 7 deg C (45 deg F).

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

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 10 and 35 deg C (50 and 95 deg F).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 3 deg C (5 deg F) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Benjamin Moore & Co.
2. PPG Paints.
3. Pratt & Lambert.
4. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Wood: 15 percent.
3. Gypsum Board: 12 percent.

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 Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Aluminum Substrates: Remove loose surface oxidation.

G. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations 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 equipment rooms:

a. Equipment, including panelboards .
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
i. Other items as directed by COTR.

2. Paint the following work where exposed in occupied spaces:

a. Equipment (mechanical and electrical), including panelboards.
b. Unistrut and anchors
c. Ductwork
d. Uninsulated metal piping.
e. Uninsulated plastic piping.
f. Pipe hangers and supports.
g. Metal conduit.
h. Plastic conduit.
i. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
j. Other items as directed by COTR.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by COTR, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 5.1S:

a. Prime Coat: Primer, rust inhibitive, water based MPI #107.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

B. Hollow Metal Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 5.1S

a. Prime Coat: Primer, rust inhibitive, water based MPI #107.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

C. Galvanized/Non-Galvanized Metal Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 5.3N:

a. Prime Coat: Primer, galvanized, water based, MPI #134.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

D. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 5.4G:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.

E. Wood Substrates: Plywood paneling.

1. Institutional Low-Odor/VOC Latex System MPI INT 6.3V:

    a. Prime Coat: Primer, latex, for interior wood**,** MPI #39.
    b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
    c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)**,** MPI #145.

F. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:

    a. Prime Coat: Primer sealer, interior, institutional low odor/VOC**,** MPI #149.

    b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
    c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3)**,** MPI #145.

END OF SECTION 09 9123

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

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 signs that are directly attached to the building.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs and Area of Rescue signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Room-Identification Signs: Full-size Sample.
2. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
3. Exposed Accessories: Full-size Sample of each accessory type.
4. Full-size Samples, if approved, will be returned to Contractor for use in Project.

E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Deterioration of finishes beyond normal weathering.
    b. Deterioration of embedded graphic image.
    c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Types:
   a. Type A: Room Identification Signs with Room Name and number.
   b. Type B: Area of Rescue Assistance Signs.

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ace Sign Systems, Inc.
   b. Advance Corporation; Braille-Tac Division.
   c. Allen Industries, Inc.
   d. APCO Graphics, Inc.
   e. ASI Sign Systems, Inc.
   f. Best Sign Systems Inc.
   g. Bunting Graphics, Inc.
   h. InPro Corporation.
   i. Mohawk Sign Systems.
   j. Nelson-Harkins Industries.
   k. Seton Identification Products.
   l. Supersine Company (The); Division of Stamp-Rite, Inc.
   m. Vista System.

3. Laminated-Sheet Sign: Sandblasted polymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.

   a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
   b. Surface-Applied Graphics: Applied vinyl film.
   c. Color(s): As selected by COTR from manufacturer's full range.

4. Sign-Panel Perimeter: Finish edges smooth.

   a. Edge Condition: Bullnosed.
   b. Corner Condition in Elevation: Square.

5. Frame: Unframed.

6. Mounting: Manufacturer's standard method for substrates indicated with concealed anchors.

7. Text and Typeface: Accessible raised characters and Braille typeface as selected by COTR from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.
8. Flatness Tolerance: Sign panel shall remain flat or uniformly curved under installed conditions as indicated and within a tolerance of plus or minus 1.5 mm measured diagonally from corner to corner.

2.3 SIGN MATERIALS

A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.

C. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, 1.2-mm nominal thickness.

D. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated and suitable for exterior applications.

E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.

5. Internally brace signs for stability and for securing fasteners.
6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

2.6 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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 signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchor inserts are correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

A. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standards ABAAS and ICC/ANSI A117.1.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

SECTION 111916 - DETENTION GUN LOCKERS

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. Pistol lockers.
2. Tilt-out pistol lockers.

B. Related Requirements:

1. Section 087163 "Detention Door Hardware" for cylinders and keying for detention gun lockers.
2. Section 125500 "Detention Furniture" for detention furniture.

1.3 COORDINATION

A. Detention Specialist: Coordinate with Section 013513.16 "Special Project Procedures for Detention Facilities" for requirements of this Section that are to be performed by a Detention Specialist or other entity.

B. Coordinate installation of anchorages for detention gun lockers. 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 adjacent construction. Deliver such items to Project site in time for installation.

C. Coordinate size and location of recesses in wall construction to receive recessed detention gun lockers.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [**Project site**]

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for detention gun lockers.

B. Shop Drawings: For detention gun lockers.

1. Include plans, elevations, sections, and attachment details.
2. Indicate locations, dimensions, and profiles of wall and floor reinforcements.
3. Indicate locations and installation details of built-in anchors.
4. Show elevations and indicate dimensions of detention gun lockers, preparations for receiving anchors, and locations of anchorage.
5. Show details of attachment of detention gun lockers to built-in anchors.

C. Samples for Initial Selection: For detention gun lockers with factory-applied color finishes.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Examination reports documenting inspections of substrates, areas, and conditions.

C. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

D. Field quality-control reports documenting inspections of installed products.

1. Field quality-control certification signed by Contractor[**and Detention Specialist**].

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.8 FIELD CONDITIONS

A. Field Measurements: Verify openings for recessed detention gun lockers by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PISTOL LOCKERS

A. Cabinet: Minimum 20 inches (508 mm) wide by 15 inches (381 mm) high by 10 inches (254 mm) deep; formed from [**0.134-inch (3.42-mm) nominal-thickness steel sheet**] [**0.141-inch (3.57-mm) nominal-thickness stainless-steel sheet**]. Line each compartment with mothproofed felt or nonabsorbing, closed-cell padding.

1. Compartments: [**Six**] <**Insert number**>.

B. Doors: Formed from [**3/16-inch- (4.8-mm-) thick steel plate**] [**0.180-inch (4.55-mm) nominal-thickness steel sheet**] [**same material as cabinet**], supported by heavy-duty continuous bottom hinge.

C. Locks: [**Snap**] [**Cylinder**] type, keyed differently[**and master keyed**]; provide one lock for each compartment.

1. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087163 "Detention Door Hardware."

D. Mounting: [**Surface**] [**Recessed, with mounting flange formed from same material as body**].

E. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
3. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
4. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.

F. Finishes:

1. Steel Factory Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
2. Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

a. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**] <**Insert color and gloss**>.

3. Stainless-Steel Finish:

a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
b. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1) Run grain of directional finishes with long dimension of each piece.
2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3) Directional Satin Finish: No. 3.

2.2 TILT-OUT PISTOL LOCKERS

A. Cabinet: Minimum 39 inches (991 mm) wide by 15 inches (381 mm) high by 6 inches (152 mm) deep; formed from [**0.134-inch (3.42-mm) nominal-thickness steel sheet**] [**0.141-inch (3.57-mm) nominal-thickness stainless-steel sheet**].

1. Compartments: [**Six**] <**Insert number**>.

B. Tilt-Out Compartments: Doors formed from [**3/16-inch- (4.8-mm-) thick steel plate**] [**0.180-inch (4.55-mm) nominal-thickness steel sheet**] [**same material as cabinet**], supported by heavy-duty continuous bottom hinge, with attached tilt-out compartment with formed metal sides. Line each compartment with mothproofed felt or nonabsorbing, closed-cell padding.

C. Locks: [**Snap**] [**Cylinder**] type, keyed differently[**and master keyed**]; provide one lock for each compartment.

1. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087163 "Detention Door Hardware."

D. Mounting: [**Surface**] [**Recessed, with mounting flange formed from same material as body**].

E. Materials:

1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
3. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
4. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.

F. Finishes:

1. Steel Factory Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
2. Steel Baked-Enamel or Powder-Coat Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish, consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

a. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**] <**Insert color and gloss**>.

3. Stainless-Steel Finish:

a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
b. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1) Run grain of directional finishes with long dimension of each piece.

2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3) Directional Satin Finish: No. 3.

2.3 FABRICATION

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of detention gun lockers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Shear and punch metals cleanly and accurately. Remove burrs.

D. Form and grind edges and corners to be free of sharp edges or rough areas.

E. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

F. Weld corners and seams continuously to comply with referenced AWS standard and 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 exposed welds and surfaces smooth and blended at exposed connections, so that no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
5. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

G. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention gun lockers rigidly in place and to support expected loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.

H. Cut, reinforce, drill, and tap detention gun lockers as indicated to receive hardware, fasteners, and similar items.

I. Form exposed work true to line and level with accurate angles, surfaces, and straight sharp edges.

J. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

2.4 ACCESSORIES

A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

B. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to [**4**] <**Insert safety factor**> times the load imposed, as determined by testing according to ASTM E488/E488M, conducted by a qualified testing agency; of type indicated below.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed; hot-dip galvanized according to ASTM A153/A153M or ASTM F2329/F2329M.

C. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch (4.8 mm) thick; with minimum 1/2-inch- (12.7-mm-) diameter, headed studs welded to back of plate.

D. Proprietary Built-in Masonry Anchors: Fabricated from [**0.134-inch (3.42-mm) nominal-thickness steel sheet**] [**1/4-inch (6-mm) nominal-thickness steel plate**] [**1/2-inch (12.7-mm) nominal-thickness steel plate**] into [**6-inch- (152-mm-)**] [**8-inch- (203-mm-)**] deep blocks matching size of concrete masonry units[**; with weld nuts attached on inside to receive field-bolted attachments**].

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Finish: [**Factory primed for field painting for anchors with field-welded attachments**] [**Polyester powder coat for anchors with bolted attachments**] [**Epoxy paint for anchors with bolted attachments**].

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

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 detention gun lockers.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention gun lockers before detention gun locker installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of detention gun lockers.

D. Inspect built-in and cast-in anchor installations, before installing detention gun lockers, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

E. Verify locations of detention gun lockers with those indicated on Shop Drawings.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention gun lockers to in-place construction. Include threaded fasteners for [**concrete**] [**and**] [**masonry**] inserts and other connectors.

B. Cutting, Fitting, and Placement: Obtain manufacturer's written approval for cutting, drilling, and fitting required for installing detention gun lockers. Set detention gun lockers accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into [**concrete**] [**or**] [**masonry**] or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

E. Adjust doors and latches of detention gun lockers to operate easily without binding. Verify that integral locking devices operate properly.

F. Assemble detention gun lockers requiring field assembly with security fasteners with no exposed fasteners on exposed faces and frames.

3.3 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Remove and replace detention work if inspections indicate that work does not comply with specified requirements. Remove malfunctioning units; replace with new units.

C. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

D. Prepare field quality-control certification[**, endorsed by Detention Specialist,**] that states installed products and their installation comply with requirements in the Contract Documents.

END OF SECTION 111916

SECTION 113013 - RESIDENTIAL APPLIANCES

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. Cooking appliances.
2. Refrigeration appliances.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Product Schedule: For appliances.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of appliance.

C. Field quality-control reports.

D. Sample Warranties: For manufacturers' special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintains, within 50 miles (80 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

1.8 WARRANTY

A. Microwave Oven: Limited warranty, including parts and labor for first year and parts thereafter.

B. Refrigerator/Freezer, Sealed System: Limited warranty, including parts and labor.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain residential appliances from single source.

2.2 PERFORMANCE REQUIREMENTS

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

2.3 MICROWAVE OVENS

A. Microwave Oven E-1

1. Manufacturer: GE Profile or equal.
2. Mounting: Countertop.
3. Type: Convection.
4. Dimensions:

a. Width: **24 inches (610 mm)**max.
b. Depth: **19-1/2 inches (495 mm)**.
c. Height: **14 inches (356 mm)** max.

5. Capacity: **1.5 cu. ft. (0.04 cu. m)**.
6. Oven Door: Door with observation window and push button.
7. Microwave Power Rating: 1100 Watts.

8. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
9. Controls: Digital panel controls and timer display.
10. Other Features: Turntable.
11. Material: Stainless steel.

2.4 REFRIGERATOR/FREEZERS

A. Refrigerator/Freezer E-2: Two-door refrigerator/freezer with freezer on top and complying with AHAM HRF-1.

1. Frigidaire or equal.
2. Type: Freestanding.
3. Dimensions:

    a. Width: **33 inches (838 mm)** max.
    b. Depth: **34 inches (863 mm) max**.
    c. Height: **66 inches (1676 mm)**.

4. Refrigerator Features:

    a. Interior light in refrigeration compartment.

5. Freezer Features: One freezer compartment with door.

    a. Automatic defrost.

6. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.

7. Appliance Color/Finish: Stainless steel.

2.5 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install appliances according to manufacturer's written instructions.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Operational Test: After installation, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

END OF SECTION 113013

SECTION 123216 - MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

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. Plastic-laminate-clad casework.
2. Casework hardware and accessories.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring casework.
2. Section 123623.13 "Plastic-Laminate-Clad Countertops."

1.3 DEFINITIONS

A. Definitions in the AWI/AWMAC/WI's "Architectural Woodwork Standards" apply to the Work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 COORDINATION

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

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plastic-laminate-clad casework.

1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.

2. Indicate types and sizes of casework.
3. Indicate manufacturer's catalog numbers for casework.
4. Show fabrication details, including types and locations of hardware.
5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and equipment.

C. Samples: For casework and hardware finishes.

D. Samples for Initial Selection: For casework and hardware finishes.

E. Samples for Verification: For the following:

1. Plastic Laminates: **8 by 10 inches (200 by 250 mm)** for each type, color, pattern, and surface finish required.

a. Provide one Sample applied to core material with specified edge material applied to one edge.

b. Provide edge banding on one edge.

1.7 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

B. Field quality-control reports.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during remainder of construction period. Maintain temperature and relative humidity during remainder of construction period in range recommended for Project location by the AWI/AWMAC/WI's "Architectural Woodwork Standards."

B. Field Measurements: Where casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.

C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of components or other failures of glue bond.
b. Warping of components.
c. Failure of operating hardware.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain from single source from single manufacturer.

2.2 GENERAL REQUIREMENTS FOR CASEWORK

A. Quality Standard: Unless otherwise indicated, comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.

1. Grade: Custom.

B. Product Designations: Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-clad casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 010000 "General Conditions."

2.3 PLASTIC-LAMINATE-CLAD CASEWORK

A. Design: Frameless cabinet construction with the following door and drawer-front style:

1. Flush overlay.

B. Exposed Materials:

1. Plastic-Laminate Grade: HGS.

a. Colors and Patterns: As selected by COTR from manufacturer's full range.

C. Semiexposed Materials:

1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.

    a. Colors and Patterns: As selected by COTR from manufacturer's full range.
    b. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.

D. Concealed Materials:

1. Plywood: Hardwood plywood.

2.4 CABINET HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish commercial-quality, heavy-duty hardware.

1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Butt Hinges: Stainless steel semiconcealed, five-knuckle hinges complying with ANSI/BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two hinges for doors less than 48 inches (1220 mm) high, and provide three hinges for doors more than 48 inches (1220 mm) high.

C. Wire Pulls: Solid stainless steel wire pulls, fastened from back with two screws.

1. Provide two pulls for drawers more than 24 inches (600 mm) wide.

D. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.

1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.
2. Drawers: Provide one bumper on back side of drawer front at each corner.

E. Drawer Slides: ANSI/BHMA A156.9, Type B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-overtravel-extension type; zinc-plated, steel ball-bearing slides.
2. Box Drawer Slides: Grade 1 for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.

F. Adjustable Shelf Supports: Mortise-type, zinc-plated steel standards and shelf rests complying with ANSI/BHMA A156.9, Type B04071 and Type B04091.

2.5 MATERIALS

A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.

C. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Source Limitations: Obtain from single source from single manufacturer.

D. PVC Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3.0 mm thick at doors and drawer fronts, 1.0 mm thick elsewhere.

2.6 FABRICATION

A. Plastic-Laminate-Clad Cabinet Construction: As required by referenced quality standard, but not less than the following:

1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch (19-mm) particleboard.
2. Shelves: 1-inch- (25-mm-) thick particleboard.
3. Backs of Casework: 1/4-inch- (6.4-mm-) thick, veneer-core hardwood plywood dadoed into sides, bottoms, and tops where not exposed.
4. Drawer Fronts: 3/4-inch (19-mm) particleboard.
5. Drawer Sides and Backs: 1/2-inch- (13-mm-) thick veneer-core hardwood plywoodwith glued dovetail or multiple-dowel joints.
6. Drawer Bottoms: 1/4-inch- (6.4-mm-) thick hardwood plywood glued and dadoed into front, back, and sides of drawers. Use 1/2-inch (13-mm) material for drawers more than 24 inches (600 mm) wide.
7. Doors 48 Inches (1220 mm) High or Less: 3/4 inch (19 mm) thick, with particleboard or MDF cores.

B. Filler Strips: Provide as needed to close spaces between casework and walls, ceilings, and equipment. Fabricate from same material and with same finish as casework.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Grade: Install casework to comply with same quality standard grade as item to be installed.

B. Install casework level, plumb, and true in line; shim as required using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm). Bolt adjacent cabinets together with joints flush, tight, and uniform.

D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).

E. Fasten casework to adjacent units and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI/AWMAC/WI's "Architectural Woodwork Standards."

F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

G. Adjust operating hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 CLEANING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 123216

SECTION 12 3661.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.

B. Related Requirements:

1. Division 22 for sinks and plumbing fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 150 mm (6 inches) square.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

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. DURAT USA. Basis of Design: 100.
b. Formica Corporation.
c. Wilsonart LLC.

2. Properties:
a. Recycled content: 28% or greater.
b. Red list free, 100% recyclable.
c. Manufactured in USA.
3. Colors and Patterns: As selected by COTR from manufacturer's full range.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: 19-mm (3/4-inch) bullnose.

2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: 19-mm- (3/4-inch-) thick, solid surface material.

D. Backsplashes: 19-mm- (3/4-inch-) thick, solid surface material.

E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

F. Joints: Fabricate countertops without joints.

G. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 5 mm (3/16 inch) into fixture opening.

2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.
2. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 3 mm in 2.4 m (1/8 inch in 8 feet), 6 mm (1/4 inch) maximum. Do not exceed 0.4-mm (1/64-inch) difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

H. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 12 3661.16

SECTION 13 3423 – FABRICATED STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 01-General Requirements and Section 01 1000 Supplementary Conditions for Construction, apply to this Section.

B. Electrical service supply and connection.

C. Site/foundation work.

D. Unloading, placement, installation and anchoring.

E. Plumbing & piping (if required).

1.2 SUMMARY

A. Section Includes:

1. All labor, equipment and materials to furnish one prefabricated Security Guard Booth.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for guard booths.
2. Include rated capacities, operating characteristics, and electrical characteristics, for included systems.

B. Shop Drawings: For guard booths. Include plans, elevations, sections, details, accessories, and fastening and anchorage details, including mechanical fasteners.

1. Anchor-Bolt Plans: Submit anchor-bolt plans and templates. Include location, diameter, and projection of anchor bolts required to attach control booths to foundation. Indicate post reactions at each location.

C. Samples: For each exposed product and for each color and texture specified, Approximately 8-1/2 by 11 inches (215 by 280 mm) in size.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For each type of exposed finish in manufacturer's standard sizes.

1. Include Samples of wall panels and accessories to verify finish selection.

F. Delegated-Design Submittal: For fabricated control booths, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For control booths to include in maintenance manuals.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair finish or replace control booths that fail in materials or workmanship within specified warranty period.

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

1.7 QUALITY ASSURANCE

A. Structures shall be the product of a manufacturer with a minimum of 20 years-documented experience in the design and fabrication of portable steel buildings.

B. Prefabricated buildings by manufacturers other than the one approved shall submit sufficient data to enable approval to be given. As a minimum: design drawings and/or calculations, applicable certifications, catalog information, and color samples showing equal range of variety.

C. Design loads: Live Loads: Per requirements for the installation location. Unit to be manufactured to be in full compliance with the Jurisdiction the booth is located in. If that Jurisdiction has Modular Building approval program requirements, manufacture to obtain Jurisdiction approval and third party inspection prior to shipping, including the Jurisdiction approval Insignia affixed to the booth before shipping.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design fabricated control booths.

B. Structural Performance: Fabricated control booths shall withstand the following loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7:

1. Loads: Per local codes.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Ballistic Resistance: Provide components, including windows, walls, and doors, identical to those tested for compliance with requirements indicated, and as follows:

1. UL Rating: Listed and labeled as Level 7 when tested in accordance with UL 752.

E. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 and marked for intended location and application.

F. Safety Glazing: Comply with 16 CFR 1201, Category II.

1. Safety Glazing Labeling: Permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction, indicating manufacturer's name, glass type, thickness, and safety glazing standard with which glass complies.

G. Regulatory Requirements: Comply with applicable provisions in The U.S. Department of Justice 2010 ADA Standards for Accessible Design and ICC A117.1.

2.2 MANUFACTURERS

A. Products of the following manufacturer from the basis for design and quality intended or equal as approved by COTR in accordance with Section 01 1000 Request For Substitutions.
1. B.I.G. Enterprises, Inc. South El Monte CA. 800-669-1449.

2.3 STRUCTURE

A. Prefabricated steel building shall be single unit welded construction. Building to be shipped completely assembled. All welded joints ground smooth. Dimensions to be 10’-0’ x 10’-0” (3048mmx3048mm). Booth shall have designated protection level in ALL areas from the finished floor height up to the finished ceiling height. The roof, fascia, overhang, soffit and floor are not protected.

B. Steel structure to be 3”x3”x0.083” in compliance with local energy codes. Framing is cold drawn electro-0welded structural mechanical steel frames.

C. WALL PANEL ASSEMBLY
1. 16ga. Galvanized steel interior walls and U.L. Level 7 armor plate steel exterior. Walls to be insulated to R-17.

D. BASE AND FLOOR
1. Unit to have a 12ga. galvanized steel plate floor welded to a 2” x 2” or 2” x 3” perimeter galvanized steel tube frame with structural galvanized steel joists welded to the frame.

Floor deck to be covered with 20” square black polyvinyl chloride interlocking tiles and a 4” black base cove.

E. DOOR
1. Swinging Doors: 1-3/4 inches (44 mm) thick; tubular-frame design fabricated from galvanized steel; with full height of door glazed. Equip door with deadlock, three butt hinges, closer, and full weather stripping.
2. Glazing: Fixed unit with ballistic rated glass.
3. Deadlock: Mortised, with lever handle and removable cylinder capable of being master keyed.

F. WINDOWS
1. 16ga. galvanized steel window frame system with flush mounted corners and welded fastening. Unit to have fixed windows on all sides, all windows glazed with U.L. Level 7 tinted laminated glass clad polycarbonate.

G. ROOF/CEILING Assembly
1. Roof surface shall be constructed of internal steel framing and joists with a 16-gauge galvanized roof deck welded to the framing. Roof shall then be coated with a three part Energy Star elastomeric membrane for weather protection with a SRI index of 95 or better. Roof structure to be insulated to R-19 minimum, and shall have a 12” tall fascia with 6” overhang. Roof to be designed to drain through a gutter system with downspouts, and shall have removable lifting eyes.
2. Interior Ceiling Panel: Fabricated from 0.079-inch (2.01-mm) nominal-thickness, galvanized-steel sheet; with fiberglass insulation in cavity between ceiling and roof.
3. Canopy Fascia: Fabricated from 0.079-inch (2.01-mm) nominal-thickness, galvanized-steel sheet, of manufacturer's standard design.

    a. Height: As indicated on drawings.
    b. Configuration:

        1) Overhang as indicated on drawings.

4. Downspouts: Integral, extending 6 inches (152 mm) beyond booth walls.

H. Work Counters:
1. Full width of control booth, reinforced; with 16-inch- (406-mm-) wide drawer below each counter and an access opening for electrical cords at each rear corner of counter.
2. Material: 0.078-inch- (1.98-mm-) thick, stainless steel sheet.
3. Depth: 22 inches (559 mm).
4. Height: 34” (864mm) AFF.

I. ELECTRICAL
1. Single-point connection: Service-entrance-rated, fused safety switch located on exterior for connection of 125 Amp rated 120/240 volt, single phase, 3 wire 12 pole with 40 amp main breaker.
2. Grounding: Grounding electrode bonded to equipment ground conductor at single-point connection in accordance with NFPA 70 and Section 260526 "Grounding and Bonding for Electrical Systems."

3. Power Distribution: Readily accessible panelboard in accordance with Section 262416 "Panelboards" installed at interior location coordinated with COTR. Include 25 percent provisions for installation of additional future devices.
4. Power Connections:
    a. One duplex, weatherproof, ground-fault circuit interrupter (GFCI), NEMA 5-15R power outlet(s) for servicing exterior equipment.
    b. Two 120V duplex outlets mounted under the shelf.
    c. Two Type USB-A power outlet(s) above counter(s) for charging portable devices.
    d. Provide power connections and means of disconnect for interior and exterior HVAC equipment.
    e. Provide power connections and means of disconnect for vehicle control equipment.
5. Lighting
    a. Booth Interior: LED lights recessed in a 16ga. galvanized steel ceiling with single pole wall switch.
    b. Booth Exterior: LED, located above door. Provide not less than 0.5-fc (5-lux) average horizontal illuminance, with uniformity not exceeding 3:1 maximum-to-minimum, when measured at finished grade over the distance of 15 ft (4.5 m) from entrance door.
    c. Controls: Provide manual switches for interior and exterior lighting on wall inside booth door.

J. HVAC Unit
1. Through-wall-mounted air conditioner with 12,000 BTU cooling and 11,200 BTU electric heating at 230 volts. HVAC to be mounted in a painted steel shroud.

K. Accessories:
1. Antifatigue mats.

L. Anchorage
1. Postinstalled anchors fabricated from non-ferrous or corrosion-resistant materials, with allowable load or strength design greater than or equal to the design load, as determined by testing conducted by a qualified testing agency.

M. Materials:

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, commercial quality, G90 (Z275) coating designation; mill phosphatized.
2. Galvanized Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D); hot-dip galvanized in accordance with ASTM A123/A123M.
3. Steel Structural Tubing: ASTM A500/A500M, Grade B.
4. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
5. Steel Mechanical Tubing: ASTM A513, welded-steel mechanical tubing.
6. Zinc-Coated (Galvanized) Steel: Hot-dip galvanized in accordance with ASTM A123/A123M.
7. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
    a. Sheet: ASTM B209 (ASTM B209M).
    b. Extruded Shapes: ASTM B221 (ASTM B221M).

c. Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T4 or Alloy 6061-T6.

8. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
9. Plastic Laminate: NEMA LD 3, Grade HGS or HGL.
10. Plywood: DOC PS 1, Exterior grade.
11. Ballistic-Resistant Glazing: Tested to comply with bullet-resistant testing level indicated.

N. Finish:
1. Immediately after cleaning and pretreating, apply manufacturer's standard baked-on finish, including thermosetting, electrostatically applied, and powder coatings. Comply with coating manufacturer's written instructions for applying and baking.
2. As selected by COTR from manufacturer’s full range.

O. WEATHER PROOFING
1. Weather-tight for exterior use. All seams and joints pressure bonderized. All openings fully weather stripped. Roof shall have heat protective membrane coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including concrete bases; accurate placement, pattern, and orientation of anchor bolts; critical dimensions; and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical and communication systems to verify actual locations of connections before control booth 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 INSTALLATION

A. Units shall be shipped fully assembled, fully wired, fully glazed and thoroughly painted.

B. Install control booths in accordance with manufacturer's written instructions.

C. Set control booths plumb and aligned. Level baseplates true to plane, with full bearing on concrete bases.

D. Fasten control booths securely to concrete base with anchorage indicated.

E. Connect to electrical power service and communication systems.

F. Seal around edges where the floor base meets the concrete pad.

G. Perform startup checks of heating and cooling units in accordance with manufacturer's written instructions.

3.3 ADJUSTING

A. Adjust doors, operable windows, and hardware to operate smoothly, easily, properly, and without binding. Confirm that locks engage accurately and securely without forcing or binding.

B. Adjust interior and exterior lighting controls.

C. Lubricate hardware and other moving parts.

D. After completing installation, inspect exposed finishes and repair damaged finishes.

END OF SECTION 13 3423

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe labels.
2. Valve tags.
3. Hydraulic Design Information Signs

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Valve Schedules: Valve numbering scheme.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 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. 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 2 inches high.

D. Pipe-Label Colors

1. Background Color: Red
2. Letter Color: White

2.2 VALVE TAGS

A. Valve Tags: Stamped or engraved with ¼ inch letters for piping-system abbreviation and ½ inch numbers.

1. Tag Material: Brass, 1/8 inch thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain.
3. Valve-Tag Color: Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open or closed), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.
2. Valve-tag schedule shall be provided in the fire pump room.

2.3 HYDRAULIC DESIGN INFORMATION SIGNS

A. Hydraulic design information signs: metal with hydraulic data permanently stamped or etched.

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 LABEL INSTALLATION

3.3 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.

3.4 LABEL INSTALLATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Pipe-Label Locations: Locate pipe labels where piping is above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. Exposed areas not required.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule. Locate valve tag schedule in the fire pump room.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Sprinkler and Standpipe Systems: 1-1/2 inches, round.

3.6 HYDRAULIC DESIGN INFORMATION SIGN INSTALLATION

A. Install hydraulic design information signs with corrosion resistant chains; locate at sprinkler zone control assemblies in the Stair, at the top of the remote standpipe and at the dry-pipe riser assembly.

END OF SECTION 210553

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.

B. The following sections apply to the work of this section:

1. 078413 Penetration Firestopping
2. 210553 Identification for Fire-Suppression Piping and Equipment
3. 283111 Digital, Addressable Alarm System

1.2 SUMMARY

A. Scope: Provide a complete, code compliant modifications to the existing sprinkler system to accommodate the renovations associated with the project. Systems shall be provided complete and ready for operation.

B. The work includes designing and installing automatic wet-pipe fire extinguishing sprinkler systems for Ordinary Hazard Group 2 including uniform distribution of water by hydraulic design to afford complete fire protection coverage throughout the contract area, unless otherwise indicated on the drawings.

C. Existing Sprinkler Equipment: Existing sprinkler equipment shall be maintained fully operational until the new equipment has been tested and accepted by the COTR and OSHEM fire protection engineer. After acceptance of the new equipment, all existing equipment so indicated shall be removed.

1. All fire suppression systems outside of the areas of work shall remain active and in service at all times during the course of the project.

D. Authority Having Jurisdiction: Any reference in the specifications or applicable codes to the "authority having jurisdiction" shall be interpreted to mean the OSHEM Fire Protection Engineer.

E. Comply with NFPA 13, all contract documents, and the Smithsonian Fire Protection and Life Safety Design Manual.

1.3 DEFINITIONS

A. COTR: Contracting Officer Technical Representative

B. FM: FM Global (Factory Mutual)

C. FPE: Fire Protection Engineer

D. Furnish: To supply the stated equipment or materials

E. Install: To set in position and connect or adjust for use

F. NFPA: National Fire Protection Association

G. NICET: National Institute for Certification in Engineering Technologies

H. OSHEM: Office of Safety Health and Environmental Management

I. Provide: To furnish and install the stated equipment or materials

J. UL: Underwriters Laboratories

1.4 SYSTEM DESCRIPTION:

A. The design shall conform to NFPA 13 and the requirements specified herein. Design of the automatic wet pipe sprinkler system shall be for Ordinary Hazard Group 2 as shown on the drawings and by hydraulic calculations unless indicated otherwise on the drawings. The design, equipment, materials, installation, workmanship, examination, inspection and testing shall be in strict accordance with NFPA 13, except as modified herein.

B. The system shall include all materials, accessories, and equipment to provide a system complete and ready for use.

C. Design and provide each system giving full consideration to obstructions, blind spaces, piping, electrical equipment, duct work and other construction and equipment in accordance with detailed drawings to be submitted for approval.

D. Equipment for fire protection service shall be UL listed or FM approved for use in wet pipe sprinkler systems.

E. In the NFPA publications referred to herein, the advisory provisions shall be considered mandatory, as though the word "shall" had been substituted for "should," wherever it appears.

1.5 PERFORMANCE REQUIREMENTS

A. Water Distribution: Distribution shall be uniform throughout the area which it is assumed the sprinkler heads will open. Variation in discharge from individual heads in the hydraulically most remote area shall be between 100 and 120 percent of the specified density.

B. Piping Restrictions: Piping is prohibited in the following areas, except when solely supplying sprinklers in such areas:

1. Transformer, switchgear, electrical or similar rooms
2. Elevator machine rooms and elevator shafts
3. Collections storage rooms

C. Clearance From Electrical Equipment: Piping and automatic sprinklers are prohibited directly over:

1. Transformers
2. Substations
3. Switchboards
4. Motor control centers
5. Emergency generators
6. Bus ducts
7. Electrical panels

D. If installing pipe over electrical equipment is unavoidable, provide drip pans under piping to protect electrical equipment.

E. Location of Sprinkler Heads: Heads in relation to the ceiling and the spacing of sprinkler heads shall not exceed their listed area of coverage for applicable NFPA 13 hazard classification. Uniformly space sprinklers on the branch piping. Locate sprinkler heads in a consistent pattern with ceiling grid, lights, and supply air diffusers.

F. Sprinkler Discharge Area: The sprinkler discharge area shall be the hydraulically most remote areas as defined in NFPA 13. Remote area reductions permitted per NFPA 13 shall not apply.

G. Hose Allowances: System design shall include an allowance of 100 gpm for inside hose stream, and 150 gpm for exterior hose stream for total combined inside and outside hose streams of 250 gpm.

H. Hydraulic Calculations: Hydraulic calculations shall be in conformance with NFPA 13 and the following requirements:

1. Water Supply: Base hydraulic calculations the current water supply test data provided by DC Water. Contractor shall provide a copy of the most recent fire pump test with the hydraulic calculations. The fire pump test may be no more than 10 months old when used for hydraulic calculations.
2. Margin of Safety: The sprinkler system shall be hydraulically designed so that the total waterflow and pressure demand is at least 20% less than the available water flow and pressure at the site.
3. Friction Losses: Calculate losses in piping in accordance with the Hazen-Williams formula with "C" value of 100 for unlined ductile iron piping, 120 for steel piping, 140 for cement-lined ductile-iron piping, 150 for copper tubing and plastic piping.
4. Flow Velocity: Piping shall be sized so that the water flow velocity does not exceed 20 ft/sec at any point in the system during maximum water flow (including inside hose demand). Flow velocity in each pipe segment is to be provided in the calculations.
5. Test Point: Calculations shall be brought back to located of water supply test information.
6. Area of Coverage and Density: The area of coverage and density for each sprinkler shall be provided in the calculations.
7. Equivalent Lengths: The equivalent lengths for all types of fittings and valves used shall be provided.
8. Supply and Demand Graph(s): A graph comparing the water supply and the sprinkler and hose stream demand for each remote area shall be provided. Pressure and flow values for the supply and demand curves are to be provided on $N^{1.85}$ graph paper.

1.6 SUBMITTALS

A. Partial submittals will not be acceptable. Any installation work performed prior to the approval of the submittal shall be at the Contractor's own risk.

B. Before any work is commenced, submit manufacturer's data (with listing or approval), system calculations, water supply data, and complete sets of working drawings.

C. The OSHEM Fire Protection Engineer shall review and approve submittals.

D. Manufacturers' Data: Annotate descriptive data to show the specific model, type and size of each item the Contractor proposes to furnish. Include data for proper installation of each system including:

1. Pipe and fittings
2. Sprinkler heads
3. Pressure and waterflow switches
4. Pipe Hangers and Supports
5. Tamper switches
6. Inspector's test station
7. Lubricating compound/PTFE tape.
8. Signs
9. Caps, chains
10. Drip pans

E. Shop Drawings: Prepare working drawings on sheets not smaller than 24 in by 36 in, in accordance with the requirements for "Working Plans" as specified in NFPA 13. A scaled site plan, with the location and elevation of the water flow test, shall be provided on the drawings. Drawings are to also include isometric diagram of sprinkler risers and feed mains, including all control valves.

F. As-Built (Record) Working Drawings: On a weekly basis, the Contractor Superintendent, in conjunction with the COTR, shall review and record as-built conditions on a set of drawings maintained at the job site. After completion, but before final acceptance of the work, furnish a complete set of as-built drawings for review and approval by OSHEM. Make all necessary corrections to the drawings and furnish four sets of as-built drawings for record purposes. All deviations from the approved shop drawings shall be highlighted on the as-built drawings; if required by OSHEM the Contractor shall also provide hydraulic calculations justifying deviations. The drawings shall not be smaller than 24 in by 36 in on reproducible sepia with title block similar to full size contract documents. Provide 1 compact disc containing CAD based drawings in DXF and PDF based format of all as-built drawings and schematics.

G. Operation and Maintenance Manuals: Furnish four (4) instruction manuals containing complete operation and maintenance instructions for the specific make and model of all check valves, detector check valves, alarm valves, waterflow and tamper switches, backflow preventers, and other trim furnished. Serial numbers and ordering information shall be provided. Place one copy of each instruction manual in a flexible, oil-resistant protective binder and mount in an accessible location.

1.7 QUALITY ASSURANCE

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. All publications listed below refer to the most current edition.

1. American Society for Testing and Materials (ASTM) Publications:

a. A53 Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless
b. A135 Welded and Seamless Steel Pipe

2. Factory Mutual System (FM) Publications

a. Approval Guide

3. National Fire Protection Association (NFPA) Publications

a. 13 Standard for the Installation of Sprinkler Systems
b. 70 National Electrical Code
c. 72 National Fire Alarm and Signaling Code
d. 101 Life Safety Code
e. 291 Recommended Practice for Fire Flow Testing and Marking of Hydrants
f. 1963 Standard for Fire Hose Connections

4. International Code Council (ICC)

a. International Building Code

5. Underwriters Laboratories, Inc. (UL) Publications:

a. Fire Protection Equipment Directory
b. 262 Gate Valves for Fire Protection Service
c. 789 Indicator Posts for Fire Protection Service

6. American Society of Mechanical Engineers (ASME)

a. A17.1 Safety Code for Elevators and Escalators

7. District of Columba Construction Code

B. Qualifications of Installer:

1. Design (including hydraulic calculations) shall be by a NICET Level III or IV Technician (in automatic sprinkler system design) or a Professional Engineer (P.E.), licensed in Fire Protection Engineering. Qualifications of the designer must be submitted to OSHEM for approval. The designer's NICET or P.E. stamp shall be present on each sheet of the working drawings.
2. Prior to installation, submit data for approval by OSHEM, showing that the Contractor has successfully installed automatic wet pipe fire extinguishing sprinkler systems of at least 200 sprinkler heads each, or there is a firm contractual agreement with a subcontractor having such required experience. These systems shall be the same type

which have been retrofitted into existing museums and historical buildings as specified herein. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. The Contractor shall indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

C. Service Organization: The Contractor shall furnish, to the COTR, evidence that there is an experienced and effective service organization which carries a stock of repair parts for the system in order to readily conduct repairs throughout the warranty period. Should the Contractor fail to comply with the service requirements of this section, the Government will then have the option to make the necessary repairs and back charge the Contractor without any loss of warranty or guarantee as provided by the contract documents.

1.8 DELIVERY STORAGE AND HANDLING

A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.

B. Store materials inside, under cover, above ground, kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

C. Automatic sprinklers must be kept in original packaging until they are installed. Loose carrying or storage is not permitted. Loose sprinklers shall be discarded immediately and replaced at Contractor's expense.

1.9 COORDINATION

A. Coordinate sprinkler head layout with reflected ceiling plan and all ceiling mounted equipment, including diffusers, lights, security cameras, fire alarm devices, exit signs, and other devices, existing and new.

B. Coordinate major equipment and piping layouts with other trades to avoid obstructions and excessive changes in direction for piping.

1.10 WARRANTY

A. The Contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by the Government.

B. Final acceptance includes, but is not limited to, the receipt and OSHEM approval of, as-built drawings and operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. All products are subject to the following listed acceptable manufacturers. If the product is not addressed herein the product shall be from a US based manufacturer and listed for fire protection use.

B. All products shall be UL Listed/FM approved.

C. Fire Protection Valves and Drain Assemblies

1. Tyco Fire & Building Products
2. Victaulic
3. Stockham
4. Kennedy
5. Jenkins
6. Reliable Automatic Sprinkler Co.
7. Viking Corporation

D. Sprinklers

1. Tyco Fire & Building Products
2. Reliable Automatic Sprinkler Co.
3. Viking Corporation
4. Victaulic Corporation

E. Valve Supervisory Switches

1. Potter Electric Signal
2. System Sensor
3. McWane, In. Kennedy Valve Div.

2.2 ABOVEGROUND PIPING SYSTEMS

A. Provide fittings for changes in direction of piping and for all connections. Arrange piping so that it can be drained at the main riser. Make changes in piping sizes through standard tapered, reducing pipe fittings; the use of bushings is not permitted. Perform welding in the shop; field welding is not permitted.

B. Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape only, applied on the male threads.

C. Use of pipe dope is not permitted.

D. Use of mechanical branch outlet type fittings is not permitted.

E. Lubricant used on gaskets for mechanical fittings must be non-petroleum based and approved by OSHEM.

F. Run piping concealed in areas with suspended ceilings, except as noted on the drawings.

G. Sprinkler Pipe and Fittings: Provide in accordance with NFPA 13, except as modified herein. Steel piping shall be Schedule 40 per ASTM A53 for sizes less than 4 inches and Schedule 10 or 40 per ASTM A53 for sizes 4 inches and larger. ASTM A135, Schedule 40 piping may be used for pipe sizes less than 2 ½ inches.

1. Standard Installation:

   a. Nominal pipe sizes 4 inches or larger: Schedule 10 or 40 Pipe meeting ASTM A-53, A- 135 or A-795 with factory- or field-formed, roll-grooved for Schedule 10 or 40 ends, or cut-grooved for Schedule 40 ends.
   b. Nominal pipe sizes smaller than 4-inches: Schedule 40 Pipe meeting ASTM A-53, A-135, and A-795 with factory- or field-formed threaded ends.
   c. For connections between 4 inch and larger pipes on risers, feed mains, cross-mains and drain lines, the requirements are as follows: .

      1) Grooved pipe couplings and fittings for grooved pipe.
      2) Outlet coupling with screwed connection for grooved pipe.

   d. For connections from risers, feed mains, cross-mains, or drains to branch lines, the requirements are as follows:

      1) Welded outlet with screwed connection or threaded coupling or fittings.

   e. For connections to and between branch line pipes less than 4 inches the requirement is as follows:

      1) Threaded pipe couplings and fittings only.

   f. For connections between drain pipes requirement is as follows:

      1) Galvanized threaded or cut-grooved pipe couplings and fittings.

2. Pressure ratings: All fittings and gaskets shall meet or exceed maximum working pressures present within the system.
3. Corrosion protection: All piping and hangers where exposed to the weather or installed in a corrosive atmosphere shall be protected against corrosion.
4. Pipe and Hanger Supports: Provide pipe supports, hangers, and clamps conforming to NFPA 13 and listed by UL or approved by FM. Provide galvanized supports, hangers, and clamps for all galvanized piping.
5. Joint Construction

   a. Procedures for welding outlets shall be in strict conformance with the welding requirements of NFPA 13, including submission of welding certifications. Welding shall not be performed on-site.
   b. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe with wall thickness less than Schedule 40.
   c. Grooved Joints and Fittings: Assemble joints and fittings with listed coupling and gasket, lubricant, and bolts from the same manufacturer. Fittings and attached couplings shall be from the same manufacturer.

d. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
e. If the galvanized coating on piping is found to be chipped or cracked upon grooving of joint, two coats of liquid galvanizing material shall be applied to groove. The first coat shall be thoroughly dry prior to applying the second coat.
f. Use of plain end fittings with mechanical couplings, hole-cut mechanical threaded outlet fittings, hole-cut mechanical grooved outlet fittings, and hole-cut saddle clamp outlet fittings are not permitted.

H. Use of restriction orifices, reducing flanges, unions, and plain-end fittings is not permitted.

I. Flanged fittings shall be used in lieu of unions with the exception of drain lines.

J. The corrosion resistance ratio of pipe and fitting method shall not be less than 0.95.

K. Pipe Hangers and Supports: Provide in accordance with NFPA 13, including hanger requirements for pressures in excess of 100 psi.

L. Identification Signs: Attach properly lettered approved metal or polycarbonate signs conforming to NFPA 13 to each valve and alarm device. Polycarbonate signs shall be red with engraved white letters. Signs at valves shall describe the sprinkler zone it controls and state that the valve is to remain open. Permanently affix design data nameplate to the riser of each system.

M. Inspector's Test Connection: Provide test connections no higher than 6 ft above the floor for each sprinkler system or portion of each sprinkler system equipped with an alarm device; locate at the control valve/drain assembly. Provide combination drain valve and test connection. Discharge shall be readily visible from the inspector's test connection, either by direct observation of the discharge or through a sight glass. Discharge shall be piped to either an open building drain or to the outside. Drainage and test valves shall be bronze globe, angle, or gate valves.

N. Drains: Provide drain piping to discharge at safe points outside the building or to sight cones attached to drains of adequate size to readily receive the full flow from each drain under maximum pressure. All drain piping and fittings are to be galvanized. Provide auxiliary drains as required by NFPA 13. Splash guards are to be provided where necessary at discharge outlets.

O. Pipe Sleeves and Seals. Provide where conduit or piping passes through walls, floors, roofs and partitions. Provide clearance between exterior of piping and interior of sleeve in accordance with NFPA 13. See Section 078413 Penetration Firestopping, for sleeves and seals through fire-rated assemblies. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through the entire thickness of walls, floors, roofs, and partitions. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: Provide ASTM A53, Schedule 40, zinc-coated steel pipe sleeves. Sleeves in floors shall project 4 inches above finished floors to prevent seepage. Sleeves in Partitions and Other than Masonry and Concrete Walls, Floors and Roofs: Sleeves shall be constructed from either zinc-coated schedule 40 steel pipe or zinc-coated 26 gauge steel sheet.

P. Escutcheon Plates: Provide one piece or split-hinge-type metal plates for piping passing through floors, walls, and ceilings in exposed and concealed areas. Provide chromium-plated or color- coordinated metal plates where pipe passes through finished ceilings. Securely anchor plates in proper position. Provide sprinkler escutcheon plates to match sprinkler head finish.

2.3 SPRINKLERS

A. Provide quick response sprinklers in mechanical spaces, stairways, corridors, offices, security rooms, telecom rooms restrooms and all other areas where their use is listed or approved. Heads located within the air streams of unit heaters or other heat-emitting equipment or skylights shall be selected for proper temperature rating.

B. Heads shall have a nominal ½ inch orifice, 5.6 k-factor for quick response sprinklers. Corrosion-resistant sprinkler heads shall be installed where they are exposed to the weather, moisture or corrosive vapors. Heads installed where they might receive mechanical injury or are less than 7 feet above the floor level, shall be protected with approved guards in accordance with NFPA 13. Provide finish as indicated.

2.4 VALVES

A. Provide valves as required by NFPA 13. Valves shall be UL listed and FM approved for fire protection service.

B. Gate Valves: Gate valves shall be the outside stem & yoke (OS&Y) type, and open by counterclockwise rotation. Gate valves installed higher than 7 feet above the floor shall be provided with a chain drive or permanently mounted ladder. Provide a gate valve beneath each alarm valve in each riser when more than one alarm valve is supplied from the same water supply pipe. For post indicator valves, provide operating nut located about 3 feet above finish grade. Gate valves for use with indicator posts shall conform to UL 262. Indicator posts shall conform to UL 789. Provide each indicator post with one coat of primer and two coats of red enamel paint.

C. Check Valves: Check valves shall be clear-opening, swing-check type, with a bronze or stainless steel seat ring and an EPDM rubber clapper facing. Flanged check valves of sizes 4 inch and larger shall have flanged inspection and access cover plates.

D. Butterfly Valves: Butterfly valves are permitted only for pipe sizes of 4 inches (100 mm) and smaller.

2.5 ALARMS

A. Paddle-Type Water Flow Switches: Provide paddle-type water flow switches as indicated on the drawings. Switches shall have sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head. Water flow switch mechanisms shall incorporate an instantly recycling, pneumatic, adjustable retard element and shall be set with a 20-second delay. Assembly shall be rated at 175 psi cold water pressure. Switches shall be compatible with the fire alarm system and shall be connected per Section 283111.

B. Valve Supervisory Switch: Valve supervisory switches shall be installed on all sprinkler control valves. The switches shall be mounted so as not to interfere with the normal operation of the valve and shall be adjusted to operate within two revolutions of the valve control or when the stem has moved no more than 1/5 of the distance from its normal open position. The mechanism shall be contained in a weather-proof, die-cast, aluminum housing that shall be provided with a ½ inch tapped conduit and incorporate the necessary facilities for attachment to the valve.

Switch housing shall be finished in red baked enamel. The entire installed assembly shall be tamper- proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting. Devices shall be compatible with and connected to the fire alarm system per Section 283111.

2.6 CABINET

A. Furnish and install a metal cabinet containing a stock of spare sprinkler heads of all types and ratings installed. The cabinet shall be located in Fire Pump Mechanical Room and where the temperature will not exceed 100ºF (37.8ºC). The number of spare sprinkler heads shall be as required by NFPA 13.

B. Provide a sprinkler head wrench in the cabinet for each type of sprinkler installed on the system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment, materials, installation, workmanship, examination, inspection and testing shall be in accordance with NFPA 13, except as modified herein. Install piping straight and true to bear evenly on hangers and supports. Install piping as close to the ceiling as possible, without interfering with other equipment and construction. Nipples shall be perpendicular to ceilings.

B. Accurately align sprinkler heads in suspended ceilings symmetrically with diffusers, lights, and ceiling tiles. Install sprinkler heads in the center of the ceiling tiles unless directed otherwise. Concealed head covers shall not be installed until ceiling construction is complete and an inspection to determine height compliance has been conducted by OSHEM.

C. Keep the interior and ends of all piping affected by Contractor's operations thoroughly clean of water and foreign matter by means of plugs or other approved methods. Inspect piping before placing into position. All pipe, fittings, and gaskets are to be cleaned of oil prior to installation.

3.2 FIELD CHANGES

A. Do not make field changes in the piping layout, pipe sizes, or type of equipment, without the prior approval of the COTR.

3.3 CONNECTIONS TO EXISTING SYSTEM

A. A schedule of any interruption of service shall be provided to the COTR and approval received before any service is interrupted. In no case shall the existing standpipe/sprinkler systems be shut off during periods other than normal Contractor construction hours.

3.4 FIELD PAINTING

A. Painting shall be per Section 099000, Painting, except as modified herein. The above-ground steel piping systems including valves, piping, pipe sleeves and hangers shall be cleaned, pre-treated, primed and painted. Coatings shall be applied only to clean, dry surfaces using clean brushes. Surfaces shall be cleaned to remove all dust, dirt, rust and loose mill scale.

B. Immediately after cleaning, provide the metal surfaces with one coat of primer, applied to a minimum dry film thickness of 1.0 to 1.5 mil. Due care shall be exercised to avoid the painting of sprinkler heads or protective devices or allowing paint to drip or splatter on any equipment, artifacts, building structures, and floors. Materials which are used to protect sprinkler heads while painting is in progress shall be removed upon completion of painting.

C. The Contractor shall remove all sprinkler heads which are painted and provide new, clean sprinkler heads of the proper type at his own expense. In addition to the primer, surfaces shall receive the following:

1. Above-Ground Piping Systems in Unfinished Areas (all areas with exposed construction): Unfinished areas are defined as attic spaces, mechanical equipment spaces, spaces above suspended ceilings, crawl spaces, pipe chases, and spaces where walls or ceilings are not painted or not constructed of a pre-finished material. Provide 2 inchwide red enamel or self-adhering plastic bands on sprinkler piping, spaced at a maximum of 10 ft intervals.
2. Above-Ground Piping Systems in Other Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except valves and operating accessories shall receive one coat of red enamel. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at a maximum of 10 ft intervals. In finished areas such as offices, the red bands may be omitted.
3. All other coatings (e.g., zinc for galvanized pipe) shall be in compliance with NFPA 13.

3.5 FIELD TESTING AND FLUSHING

A. All testing shall be scheduled with the COTR.

B. At the discretion of the OSHEM Fire Protection Engineer, an air pressure test may be required prior to filling the system with water. The test shall be conducted by raising the air pressure in the system to 40 psi and allowing it to stand for 24 hours. There shall be no loss of air pressure greater than 1.5 psi over the 24 hour period. Air pressure during this test shall be tracked via a graph over the 24 hour period by a pressure monitoring device or pressure monitoring gauge.

C. Hydrostatic tests shall be conducted at the greater of 200 psi or the normal system pressure plus 50 psi for a 2 hour period with no leakage or reduction in gage pressure. Hydrostatic test pressures shall not be maintained on the system overnight. Flush piping with potable water in accordance with NFPA 13.

D. Preliminary Tests and Procedures: Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. Prior to the hydrostatic test, perform an air test on the system. In areas where piping will be concealed by ceilings, walls, or other construction before the system is complete and ready for final testing, the preliminary hydrostatic test shall be conducted prior to piping being concealed. This test shall be witnessed

by the COTR, and the OSHEM Fire Protection Engineer. When all tests and procedures are completed and corrections made, submit a signed and dated certificate, similar to that specified in NFPA 13, with a request for formal inspections and tests.

E. Formal Inspection and Tests: At this time, all piping, sprinklers, and other system components shall be in-place and all adjustments to the system completed. The OSHEM Fire Protection Engineer shall be notified by the COTR, shall witness all tests, and shall approve all systems before they are accepted. Submit a request for a formal inspection at least five working days prior to the date the inspection is to take place. A competent representative of the sprinkler installer shall be present during testing and inspection. As-built drawings shall be on-site for the inspection. At this inspection, the system shall be hydrostatically tested. Any or all of the required tests shall be conducted by the Contractor at his own expense and additional tests made until it has been demonstrated that the systems comply with all contract requirements. The Contractor shall furnish all appliances, equipment, instruments, connecting devices and personnel for the tests. Any costs incurred by the SI for repeat tests, due to the failure of the Contractor to adequately demonstrate that the system complies with the contract requirements, shall be borne by the Contractor.

F. Connections to Existing Piping: During air and hydrostatic testing, the Contractor shall test new piping prior to connecting to the existing system. If the Contractor chooses to test the new piping while it is connected to existing piping or valves, the Contractor shall assume responsibility for all piping and equipment which is pressurized, as well as any damage caused by the failure of existing or new sprinkler systems. The SI accepts no responsibility for existing valves' performance to withstand hydrostatic pressure testing.

END OF SECTION 211313

SECTION 21 1316

PREACTION 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:

B. Pipes, fittings, and specialties.

1. Specialty valves.

2. Sprinkler specialty pipe fittings.

3. Sprinklers.

4. Alarm devices.

C. Pressure gages.

D. Related Requirements:

1. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping

2. Section 28 3111 "Addressable Fire-Alarm System" for alarm devices not specified in this Section

3. Comply with all requirements in 211313.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Preaction sprinkler system piping designed to operate at working pressure of 175-psig maximum.

B. COTR: Contracting Officer Technical Representative

C. FM: FM Global (Factory Mutual)

D. FPE: Fire Protection Engineer

E. Furnish: To supply the stated equipment or materials

F. Install: To set in position and connect or adjust for use

G. NFPA: National Fire Protection Association

H. NICET: National Institute for Certification in Engineering Technologies

I. OSHEM: Office of Safety Health and Environmental Management

J. Provide: To furnish and install the stated equipment or materials

K. UL: Underwriters Laboratories

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

2. Comply with requirements in 211313.

B. Shop Drawings: For preaction sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.
3. Comply with requirements in 211313.

1.5 INFORMATIONAL SUBMITTALS

A. Comply with requirements in 211313.

1.6 CLOSEOUT SUBMITTALS

A. Comply with requirements in 211313.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Comply with requirements in 211313.

1.8 QUALITY ASSURANCE

A. Comply with requirements in 211313.

1.9 FIELD CONDITIONS

A. Comply with requirements in 211313.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

A. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system, located in same area as sprinklers, opens deluge valve, permitting water to flow into sprinkler piping. A closed solenoid valve in the sprinkler piping is opened by another fire-detection device; water will then discharge from opened sprinklers.

2.2 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 20 percent, including losses through water-service piping, valves, and backflow preventers.

2. Minimum Density for Automatic-Sprinkler Piping Design:

a. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm (8.1 mm/min) over entire protected area.
b. Maximum Protection Area per Sprinkler: 130 sq. ft. (12.1 sq. m) for all spaces.
c. Revise "Total Combined Hose-Stream Demand Requirement" Subparagraph below to suit requirements of authorities having jurisdiction.

3. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

a. Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.

2.3 STEEL PIPE AND FITTINGS

A. Comply with the requirements in 211313

2.4 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig (1200-kPa) minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Deluge Valves:

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. Reliable Automatic Sprinkler Co., Inc. (The).
b. Tyco by Johnson Controls Company.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL 260.
3. Design: Double-interlock, hydraulically operated, differential-pressure type.
4. Include trim sets for alarm-test bypass, drain, electrical water-flow alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, and fill-line attachment with strainer and push-rod chamber supply connection.
5. Electric Release Trim Set: Include solenoid valve. Releasing solenoid shall be compatible with releasing panel. Refer to Division 28 Section Addressable Fire Alarm Systems.
6. Preaction valve assembly clappers shall incorporate a latching mechanism that will not be affected by pressure changes in the water system. In addition to automatic operation, arrange each valve for manual release at the valve. Provide pressure gauges and other appurtenances at the preaction valve. Provide a test detection device for each actuation circuit adjacent to each valve, which the device controls, as required by NFPA 13.
7. Air-Pressure Maintenance Device:

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) Reliable Automatic Sprinkler Co., Inc. (The).
2) Tyco by Johnson Controls Company.
3) Victaulic Company.
4) Viking Corporation.

b. Standard: UL 260.
c. Type: Automatic device to maintain minimum air pressure in piping.

d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig – 300 psig (1200-kPa – 2070 kPa) outlet pressure.

8. Air Compressor:

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) Engineered Corrosion Solutions.
2) General Air Products, Inc.
3) Viking Corporation.

9. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
10. Motor Horsepower: Fractional.
11. Power: 120-V ac, 60 Hz, single phase.
12. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

2.5 SPRINKLER PIPING SPECIALTIES

A. General Requirements for Dry-Pipe System Fittings: UL listed for dry-pipe service.

B. Sprinkler Inspector's Test Fittings:

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. AGF Manufacturing, Inc.
b. Tyco by Johnson Controls Company.
c. Victaulic Company.
d. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig – 300 psig (1200-kPa – 2070 kPa).
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.6 SPRINKLERS

A. Comply with the requirements in 211313.

2.7 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Pressure Switches:

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. Fire-Lite Alarms, Inc.; a Honeywell International company.
b. Kennedy Valve Company; a division of McWane, Inc.
c. Potter Electric Signal Company, LLC.
d. System Sensor.

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

C. Valve Supervisory Switches:

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. Fire-Lite Alarms, Inc.; a Honeywell International company.
b. Kennedy Valve Company; a division of McWane, Inc.
c. Potter Electric Signal Company, LLC.
d. System Sensor.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

2.8 CONTROL PANELS

A. Comply with the requirements in 28 3111.

2.9 DETECTION AND RELEASING SYSTEM

A. Comply with the requirements in 28 311.

2.10 PRESSURE GAGES

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. Ashcroft Inc.
2. Brecco Corporation.
3. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.

D. Pressure Gage Range: 0- to 250-psig (0- to 1725-kPa) minimum 0 to 300 psig (0 to 2070 kPa).

E. Label: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Secure current annual fire pump test report. Use results for system design calculations required in "Quality Assurance" Article.

B. Report pump test results promptly and in writing to the A/E.

3.2 WATER-SUPPLY CONNECTIONS

A. Connect preaction sprinkler piping feed to adjacent existing wet-pipe sprinkler main.

3.3 CONNECTIONS TO EXISTING SYSTEM

A. Comply with the requirements in 211313.

3.4 FIELD PAINTING

A. Comply with the requirements in 211313.

3.5 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

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

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.

J. Connect compressed-air supply to dry-pipe sprinkler piping.

K. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system.
3. Fire-alarm devices, including low-pressure alarm.

L. Install alarm devices in piping systems.

M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13.

N. Install pressure gages on riser or feed main and at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

O. Drain preaction sprinkler piping.

P. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices air compressors.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 211313

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 31 1313

3.6 JOINT CONSTRUCTION

A. Comply with the requirements in 211313.

3.7 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install deluge valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

    a. Install air compressor and compressed-air-supply piping.
    b. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range; and 175-psig (1200-kPa) maximum inlet pressure.
    c. Install compressed-air-supply piping from building's compressed-air piping system.

3.8 SPRINKLER INSTALLATION

A. Comply with the requirements in 211313.

3.9 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.10 FIELD QUALITY CONTROL

A. Comply with the requirements in 211313.

3.11 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.13 PIPING SCHEDULE

A. Comply with the requirements in 211313.

3.14 FIELD TESTING AND FLUSHING

A. Comply with the requirements in 211313.

END OF SECTION 211316

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. This Section includes references to Division 23 Sections for plumbing common materials and methods, in lieu of repeating the same information in Division 22. Referenced sections apply to Division 22 – Plumbing and Division 23 – Heating, Ventilation and Air Conditioning.

B. Related Sections include the following:

1. Division 01 Sustainability Sections for additional requirements related to the LEED certification process.
2. Refer to Division 23 Section “Common Work Results for HVAC” for basic materials and methods.
3. Refer to Division 23 Section “Hangers and Supports for HVAC Piping and Equipment” for hangers and supports requirements.
4. Refer to Division 23 Section “Identification for HVAC” for identification requirements.
5. Refer to Division 23 Section “HVAC Insulation” for insulation requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 220500

SECTION 220523 - VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. This Section includes the following general-duty valves:

1. Copper-alloy ball valves.

B. Related Sections include the following:

1. Division 2 piping Sections for general-duty and specialty valves for site construction piping.
2. Division 23 Section “Identification for HVAC" for valve tags and charts.
3. Division 22 piping Sections for specialty valves applicable to those Sections only.
4. Division 23 Sections “HVAC Insulation” for insulation requirements.
5. Division 23 Sections “Hangers and Supports for HVAC and Piping Equipment” for hangers and supports requirements.

1.4 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. RF: Raised face.
6. SWP: Steam working pressure.
7. TFE: Tetrafluoroethylene plastic.

1.5 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; actuators; dimensions; and required clearances. Include list indicating valve and its application. Include

rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.6 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.

1. Exceptions: Domestic hot- and cold-water piping valves unless referenced.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 372/NSF 61 for valve materials for potable-water service.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.18 for solder-joint connections.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Handlever: For quarter-turn valves smaller than 100 mm (4-inch) .

H. Valves in Insulated Piping:

1. Include 50-mm (2-inch) stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

I. Valve Bypass and Main Connections: MSS SP-45.

2.2 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.3 COPPER-ALLOY BALL VALVES

A. Manufacturers:

1. Two-Piece, Copper-Alloy Ball Valves:
   a. Conbraco Industries, Inc.; Apollo Div.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Div.
   e. Grinnell Corporation.
   f. Jamesbury, Inc.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Watts Industries, Inc.; Water Products Div.

B. Copper-Alloy Ball Valves, General: MSS SP-110.

C. Two-Piece, Copper-Alloy Ball Valves: Bronze body with full-port, solid chrome-plated brass ball; PTFE seats, seals, and packing; 4200 kPa (600-psig) minimum CWP rating; and blowout-proof brass stem.

D. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim

1. Description:
   a. Standard: MSS SP-110.
   b. CWP Rating: 600 psig (4140 kPa).
   c. Body Design: Two piece.
   d. Body Material: Bronze.

e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

2.4 EXECUTION

2.5 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

2.6 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves for water service.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Domestic and Non-Potable Water Piping: Use the following types of valves:

1. Ball Valves, DN 50 (NPS 2) and Smaller: Two-piece, 4200 kPa (600-psig) CWP rating, copper alloy.

D. Select valves, except wafer and flangeless types, with the following end connections:

1. For Copper Tubing, DN 50 (NPS 2) and Smaller: Solder-joint or threaded ends.

2.7 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access, smooth and easy actuator operation, and packing maintenance; provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

2.8 JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping joint construction.

2.9 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units

1.3 SUMMARY

A. This Section includes domestic, non-potable and non-potable water piping and water meters and water filters inside the building.

B. Related Sections include the following:

1. Division 23 Section "Meters and Gages for HVAC Piping" for thermometers, pressure gages, and fittings.
2. Division 22 Section "Plumbing Specialties" for water distribution piping specialties.
3. Division 23 Section "Identification for HVAC" for labeling and identifying domestic and non-potable water piping.
4. Division 22 Section "Valves for Plumbing Piping" for valves in domestic water piping.

1.4 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with 1035 kPa (150 psig), unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, couplings, water filters and water meters.

B. Water Disinfecting and Samples: Specified in Part 3 "Cleaning" Article.

C. Field quality-control test reports: For specified field quality-control, to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. All piping, fittings, valves and other components installed within a potable water distribution system shall comply with NSF 61 “Drinking Water System Components - Health Effects.”

C. All piping, fittings, valves and other components installed within a potable water system intended for human consumption shall comply with NSF 61 Annex G “Drinking Water System Components – Lead Content” or NSF 372 “Drinking Water System Components – Lead Content.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88M, lead-free, Types A and B (ASTM B 88, lead-free, Types K and L), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. 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 PIPE JOINING MATERIALS

A. Solder Filler Metals: ASTM B32, lead-free alloys.

B. Flux: ASTM B813, water flushable.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 VALVES

A. Bronze and cast-iron, general-duty valves are specified in Division 22 Section "Valves for Plumbing Piping."

B. Balancing and drain valves are specified in Division 22 Section "Plumbing Specialties."

PART 3 - EXECUTION

3.1 PIPE AND FITTING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Aboveground Domestic Potable Water Piping: Use the following piping materials for each size range:

1. All Sizes: Hard copper tube, lead-free Type B (Type L); copper pressure fittings; and lead-free soldered joints.

D. Aboveground Non-Potable, Non-Potable Piping: Use the following piping materials for each size range:

1. All Sizes: Hard copper tube, Type B (Type L); copper pressure fittings; and soldered joints.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use bronze ball valves for piping DN 50 (NPS 2) and smaller. Use ferrous alloy butterfly valves with flanged ends for piping DN 65 (NPS 2-1/2) and larger.
2. Throttling Duty: Use bronze ball or globe valves for piping DN 50 (NPS 2) and smaller. Use ferrous alloy butterfly valves with flanged ends for piping DN 65 (NPS 2-1/2) and larger.
3. Hot-Water-Piping, Balancing Duty: Calibrated and/or thermostatic balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping DN 50 (NPS 2) and smaller. Use butterfly valves for piping DN 65 (NPS 2-1/2) and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install stop-and-waste drain valves where indicated.

D. Install balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Balancing valves are specified in Division 23 Section “Plumbing Specialties.”

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss expansion and other considerations. Install piping, valves, etc., as indicated unless deviations to layout are approved beforehand.

B. Basic piping installation requirements are specified in Division 23 Section "Common Work Results for HVAC."

C. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."

D. Install sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

E. Install domestic water piping level without pitch and plumb.

F. Rough-in domestic water piping for water-meter installation according to utility company's and Owner’s requirements.

G. Install ductile-iron, water-service piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing.”

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

C. Ductile-Iron Piping, Restrained Mechanical Joints: AWWA C151.

D. Brazed Joints for Copper Tubing: Comply with CDA’s “Copper Tube Handbook,” “Brazed Joints” chapter.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 23 Section “Hangers and Supports for HVAC Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 30 m (100 Feet) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 30 m (100 Feet): MSS Type 43, adjustable roller hangers.
    c. Longer Than 30 m (100 Feet): MSS Type 49, spring cushion rolls, if indicated.

3. Multiple, Straight, Horizontal Piping Runs (30 m) 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 23 Section “Hangers and Supports for HVAC Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 9.5mm (3/8 inch).

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. DN 20 (NPS 3/4) and Smaller: 1500 mm (60 inches) with 10-mm (3/8-inch) rod.
2. DN 25 and DN 32 (NPS 1 and NPS 1-1/4): 1800 mm (72 inches) with 10-mm (3/8-inch) rod.
3. DN 40 and DN 50 (NPS 1-1/2 and NPS 2): 2400 mm (96 inches) with 10-mm (3/8-inch) rod.
4. DN 65 (NPS 2-1/2): 2700 mm (108 inches) with 13-mm (1/2-inch) rod.
5. DN 80 to DN 100 (NPS 3 to NPS 4): 3 m (10 feet) with 13-mm (1/2-inch) rod.
6. DN 150 (NPS 6): 3 m (10 feet) with 16-mm (5/8-inch) rod.

F. Install supports for vertical copper tubing every 3 m (10 feet).

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic, and non-potable to water-service piping with shutoff valve, and extend and connect to the following:

1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Commercial Sinks."
2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for DN 65 (NPS 2-1/2) and larger.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Division 23 Section “Identification for HVAC Piping and Equipment.”

3.8 FIELD QUALITY CONTROL

A. Inspect domestic potable and non-potable water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic potable and non-potable water piping as follows:

1. Fill all water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic and non-potable water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 345 kPa (50 psig) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 ADJUSTING

A. Perform the following adjustments before operation:
1. Open shutoff valves to fully open position.

2. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
3. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by local plumbing code or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 mg/L (5 ppm) of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 mg/L (200 ppm) of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units

1.3 SUMMARY

A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.

B. Related Sections include the following:
   1. Division 22 Section "Plumbing Specialties" for soil, waste, and vent piping systems specialties.

1.4 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 30 kPa (10-foot head) of water.
   2. Sanitary and Effluent Force Mains: 345 kPa (50 psig).

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. All cast iron soil pipe and fittings are to be produced by a single manufacturer and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI).

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. CISPI – Cast Iron Soil Pipe Handbook.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber. Gaskets shall be manufactured by the same manufacturer as for cast iron pipe.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
   1. Marked with CISPI collective trademark and NSF certification mark.

B. Shielded Couplings: ASTM C 1277 assembly of metal housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
   1. Heavy-Duty, Shielded, Stainless-Steel Couplings: Coupling standard ASTM C-1540, with stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve with integral, center pipe stop.
      a. Manufacturers:
         1) Anaco-Husky; SD-4000
         2) Clamp-All Corp.
      b. Clamps: Type 304 stainless steel.
      c. Screws: Type 305 stainless steel, minimum 9.5mm (3/8”).
      d.
      e. Shields: Type 304 stainless steel, corrugated, thickness minimum 0.015.
      f. Gasket: Neoprene conforming to ASTM C 564.

2.5 COPPER TUBING AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
   1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88M (ASTM B 88), Types A and B, (Types L and K) water tube, drawn temper.
   1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.6 SPECIALTY PIPE FITTINGS

A. Transition Coupling:
1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
2. Shielded, Non-pressure Transition Couplings:
a. Standards: ASTM C 1460 and 564.
b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant metal tension band and tightening mechanism on each end.
c. End Connections: Same size as and compatible with pipes to be joined.

B. Dielectric Fittings:
1. Dielectric Fittings:
a. Description:
1) Standard: ASTM F-492-77.
2) Electroplated steel nipple.
3) Pressure Rating: 2070 kPa (300 psig) at 107 deg C (225 deg F).
4) End Connections: Male threaded.
5) Lining: Inert and noncorrosive, thermoplastic.

2.7 NO-HUB CAST IRON PIPING RESTRAINTS

A. No-hub cast iron soil pipe fitting restraints.
1. Description: CISPI Designation 301-12 large diameter no-hub cast iron fittings, over 102 mm (4-inch) in size, with supplemental support to minimize the risk of joints separation under high thrust conditions. Auxiliary restrain products used shall be manufactured assemblies with thrust pressure rating adequate for the specific installation. Field devised methods and materials are not permitted.

B. Manufacturer:
1. Holdrite Series 117.
2. Grinnel.
3. Anvil.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Aboveground, soil, waste, and vent piping all sizes shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings with the following:
   a. Couplings: Heavy-duty, Type 304, stainless steel.

B. Underground, soil, waste, and vent piping all sizes shall be the following:
   1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

3.3 PIPING INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping installation.

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cleanout fitting with closure plug inside the building in sanitary and effluent force main piping.

D. Install underground, copper, force main tubing according to CDA's "Copper Tube Handbook."

E. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 22 Section "Common Work Results for Plumbing" for wall penetration systems.

F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

G. No-hub pipe and fitting coupling joints over 102 mm (4 inches) in size shall receive auxiliary support by means of appropriate bracing materials, per all US soil pipe and fitting manufacturers' installation instructions and per CISPI Cast iron Soil Pipe and Fittings Handbook. Auxiliary restraint products used shall be manufactured assemblies with thrust pressure rating adequate for the specific installation and shall be installed onto horizontal joints over 102 mm (4 inches) diameter in size. Field devised methods and materials shall not be used to accomplish this application solution.

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping DN 65 (NPS 2-1/2) and smaller; 1 percent downward in direction of flow for piping DN 80 (NPS 3) and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

K. Install force mains at elevations indicated.

L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in ODs.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
4. In Underground Force-Main Piping:
   a. DN 40 (NPS 1-1/2) and Smaller: Fitting-type transition couplings.
   b. DN 50 (NPS 2) and Larger: Pressure transition couplings.

B. Dielectric Fittings:
1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for DN 50 (NPS 2) and Smaller: Use dielectric nipples, unions.
3. Dielectric Fittings for DN 65 to DN 100 (NPS 2-1/2 to NPS 4): Use dielectric flanges, flange kits, nipples.
4. Dielectric Fittings for DN 125 (NPS 5) and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for pipe hanger and support devices. Install the following:
1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

a. 30 m (100 Feet) and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 30 m (100 Feet): MSS Type 43, adjustable roller hangers.
c. Longer Than 30 m (100 Feet), if indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 30 m (100 Feet) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 10-mm (3/8-inch) minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. DN 20 and DN 50 (NPS 1-1/2 and NPS 2): 1500 mm (60 inches) with 10-mm (3/8-inch) rod.
2. DN 80 (NPS 3): 1500 mm (60 inches) with 15-mm (1/2-inch) rod.
3. DN 100 (NPS 4): 1500 mm (60 inches) with 16-mm (5/8-inch) rod.
4. DN 150 (NPS 6): 1500 mm (60 inches) with 20-mm (3/4-inch) rod.
5. Spacing for 3 m (10-foot) lengths may be increased to 3 m (10 feet). Spacing for fittings is limited to 1500 mm (60 inches).

F. Install supports for vertical cast-iron soil piping every 4.5 m (15 feet).

G. In compliance with all US soil pipe and fitting manufacturers' installation instructions and per CISPI Designation 310-11, CISPI Designation 301-09 and the CISPI Cast Iron Soil Pipe Handbook, regarding auxiliary support for no-hub cast iron pipe and fitting joints over 201 mm (4 inches) in size and for joints subjected to excessive thrust forces, use manufactured assemblies with appropriate thrust pressure ratings, rather than field assembled miscellaneous materials.

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. DN 32 (NPS 1-1/4): 1800 mm (72 inches) with 10-mm (3/8-inch) rod.
2. DN 40 and DN 50 (NPS 1-1/2 and NPS 2): 2400 mm (96 inches) with 10-mm (3/8-inch) rod.
3. DN 65 (NPS 2-1/2): 2700 mm (108 inches) with 13-mm (1/2-inch) rod.
4. DN 80 to DN 100 (NPS 3 to NPS 4): 3 m (10 feet) with 13-mm (1/2-inch) rod.

I. Install supports for vertical copper tubing every 3 m (10 feet).

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Sections for all plumbing fixtures.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 30 kPa (10-foot) head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures and drains have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 250 Pa (1-inch) wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 224216.16 - COMMERCIAL SINKS

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 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units

1.3 SUMMARY

A. Section Includes:

1. Stainless steel sinks.
2. Sink faucets.
3. Laminar-flow, faucet-spout outlets.
4. Supply fittings.
5. Waste fittings.
6. Disposal.
7. Thermostatic mixing valves.

B. Related Sections include the following:

1. Division 22 Section “Domestic Water Piping” for water supply connections to sinks.
2. Division 22 Section “Sanitary Waste and Vent Piping” for sanitary waste and vent connections to sinks.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. All piping, fittings, valves and other components installed within a potable water distribution system shall comply with NSF 61 “Drinking Water System Components-Health Effects.”

B. All piping, fittings, valves and other components installed within a potable water system intended for human consumption shall comply with NSF 61 Annex G “Drinking Water System Components-Lead Content” or NSF 372 “Drinking Water System Components-Lead Content.”

PART 2 - PRODUCTS

2.1 STAINLESS STEEL SINK

A. Break Room Sink (P-1): Stainless steel, counter mounted, single compartment.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkay Manufacturing Co. Model LR1919PD
b. Just Manufacturing.
c. Advance Tabco.

2. Fixture:

a. Standard: ASME A112.19.3/CSA B45.4.
b. Type: Single bowl, top mount.
c. Number of Compartments: One.
d. Overall Nominal Dimensions: 483 by 483 by 203 mm (19 by 19 by 8).
e. Material: Seamless die-drawn construction of 18 gauge, type 304, 18-8 stainless steel. Interior surfaces shall be polished to a non-porous finish, with fully coated underside.
f. Compartment:

1) Dimensions: 406 by 356 by 203 mm (16 by 14 by 8).
2) Drain Location: Centered in compartment.
3) Drain: Provided with disposal locking mount.

3. Faucet(s): Specified herein.

a. Number Required: One.
b. Mounting: On sink rim through counter.
c. ASSE 1070 thermostatic mixing valve: Specified herein.

4. Supply Fittings: Specified herein.
5. Waste Fittings: Specified herein.
6. Mounting: On counter with sealant.
7. Disposal: Specified herein.

B. Copy "Utility Sinks" Paragraph below and re-edit for each type of stainless-steel, freestanding utility sink required.

2.2 SINK FAUCETS

A. Sink Faucets (P-1): Manual type, fixed centers, deck mounted faucet.

1. Commercial, Solid-Brass Faucets.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Chicago Faucets. Model 1100-GN8AE35-317AB
2) Zurn Plumbing Products Group.
3) Sloan
4) Moen Commercial.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
4. Body Material: Commercial, solid brass, lead-free.
5. Finish: Chrome plated.
6. Maximum Flow Rate: 0.07 L/s (1.0 gpm).
7. Handle(s): Wrist Blade handles, 100 mm (4”)
8. Mounting Type: Deck, concealed.
9. Spout Type: Swivel, solid brass, 203 mm (8”) center to center .
10. Centers: 200mm (8”).
11. Spout Outlet: Laminar flow.
12. Thermostatic Mixing Valve: ASSE 1070.

2.3 THERMOSTATIC MIXING VALVES ASSE 1070

A. Thermostatic Mixing Valve: ASSE 1070 Certified, lead-free solid bronze construction with advanced thermal actuator for low flow performance 1.5 L/min. (0.4 gpm), adjustable temperature selection with lock-down capabilities, union connections for easy maintenance and with integral check-stops and screens for preventing cross-flow and contamination.

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following:

a. Powers Model LFLM495
b. Lawler Manufacturing Co.
c. Bradley Corporation.
d. Leonard Valve Co.
e. Acorn Engineering.
f. Speakman Corporation.

2.4 SUPPLY FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. McGuire Manufacturing Co., Model #LF-2165-LK and LF-2167-LK.
2. Chicago.
3. Engineered Brass Co.
4. Brasscraft.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Lead-free chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Lead-free chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:

1. DN 10 (NPS 3/8) and DN 15 (NPS 1/2).
2. Lead-free chrome-plated, rigid-copper pipe.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. McGuire Manufacturing Co., #8912.
2. Chicago.
3. Engineered Brass Co.
4. Brasscraft.

C. Drain: Grid type with DN 40 (NPS 1-1/2) straight tailpiece.

D. Trap:

1. Size: DN 40 (NPS 1-1/2) .
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with cleanout plug with 0.83-mm (0.032-inch)-thick brass tube to wall; and chrome-plated brass or steel wall flange.

2.6 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. TureBro Lav Guard 2, Model 102 E-Z
b. McGuire Manufacturing Co.
c. Engineered Brass Company.
d. Plumberex.

2. Description: Manufactured soft, white resilient molded vinyl, self-extinguishing ASTM D-635, bacteria/fungus resistant, ASTM G 21 and G22.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Division 23 Section "General-Duty Valves for Mechanical Piping."
2. Install stops in locations where they can be easily reached for operation.

C. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Division 22 Section "Common Work Results for Plumbing."

D. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Division 07 Section "Joint Sealants."

E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks.

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Division 22 Section "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Division 22 Section "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by COTR.

END OF SECTION 224216.16

SECTION 230130.51 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

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 cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

A. ASCS: Air systems cleaning specialist.

B. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

A. Single submittal prior to commencing work, including the following:

1. Qualification Data: For an ASCS.
2. Strategies and procedures plan.

1.5 CLOSEOUT SUBMITTALS

A. Cleanliness verification report (included in operation and maintenance manuals submittal).

1.6 QUALITY ASSURANCE

A. ASCS Qualifications: A certified member of NADCA.

1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
2. Supervisor Qualifications: Certified as an ASCS by NADCA.

B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.

C. Cleaning Conference: Conduct conference at Project site.

1. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.

B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.

C. Prepare written report listing conditions detrimental to performance of the Work.

D. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:

1. Supervisor contact information.
2. Work schedule including location, times, and impact on occupied areas.
3. Methods and materials planned for each HVAC component type.
4. Required support from other trades.
5. Equipment and material storage requirements.
6. Exhaust equipment setup locations.

B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.

C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.3 CLEANING

A. Comply with NADCA ACR 2006.

B. Remove visible surface contaminants and deposits from within the HVAC system.

C. Systems and Components to Be Cleaned within the bounds of the project, include air terminal units and ductwork between units and spaces served within project scope:

1. Any existing air devices for supply and return air.
2. Existing air-terminal units.
3. Ductwork:

    a. Existing supply-air ducts, including turning vanes and reheat coils.
    b. New and existing return-air ducts within project area.
    c. Existing exhaust-air ducts.

4. Filters and filter housings.

D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.

E. Particulate Collection:

1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from air intakes and other points of entry into the building.
2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building.

F. Control odors and mist vapors during the cleaning and restoration process.

G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.

H. System components shall be cleaned so that HVAC system components are visibly clean. On completion, components must be returned to those settings recorded just prior to cleaning operations.

I. Clean air-distribution devices, registers, grilles, and diffusers.

J. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:

1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
3. Clean evaporator coils, reheat coils, and other airstream components.

K. Duct Systems:

1. Create service openings in the HVAC system as necessary to accommodate cleaning.
2. Mechanically clean duct systems specified to remove visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).

L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.

M. Mechanical Cleaning Methodology:

1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.

2. Cleaning Mineral-Fiber Insulation Components:

a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
c. Fibrous materials that become wet shall be discarded and replaced.

N. Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
3. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
4. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
5. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
6. Rinse thoroughly with clean water to remove any latent residues.

O. Antimicrobial Agents and Coatings:

1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.4 CLEANLINESS VERIFICATION

A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.

B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.

C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

D. Additional Verification:

1. Perform surface comparison testing or NADCA vacuum test.
2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.

E. Verification of Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of original pressure drop of 0.1 in w.g. (0.2 in w.g. for CV-4-5) differential measured when the coil was first installed.
3. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.

F. Prepare a written cleanliness verification report. At a minimum, include the following:

1. Written documentation of the success of the cleaning.
2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
3. Surface comparison test results if required.
4. Gravimetric analysis (nonporous surfaces only).
5. System areas found to be damaged.

G. Photographic Documentation: Comply with requirements in Section 013233 "Photographic Documentation."

3.5 RESTORATION

A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.

B. Restore service openings capable of future reopening. Comply with requirements in Section 233113 "Metal Ducts." Include location of service openings in Project closeout report.

C. Replace damaged insulation according to Section 230700 "HVAC Insulation."

D. Ensure that closures do not hinder or alter airflow.

E. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

END OF SECTION 230130.51

SECTION 230500 - COMMON WORK RESULTS FOR MECHANICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section also applies to Division 22 Plumbing Specification Sections.

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. This Section includes the following:

1. Coordination drawings.
2. Piping materials and installation instructions common to most piping systems.
3. Dielectric fittings.
4. Drives for machinery.
5. Motor starting equipment.
6. Drip pans.
7. Grout.
8. Packing material for penetrations.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Supports and anchorages.
12. Accessibility.
13. Rigging of equipment.
14. Demonstration.

B. Related Sections include the following:

1. Division 23 Section “Vibration Controls for HVAC” for piping flexible connectors.

1.4 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, AHU service corridors, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, mechanical and electrical equipment rooms, air handling unit service corridors, and accessible shafts.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations and at grade locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. Conditioned Space: Finished spaces and exposed interior spaces that are air conditioned. Examples include offices, corridors, etc., that are served by air conditioning equipment. Return-air plenums are not conditioned space.

G. Return-air Plenums: Space between ceiling and structure above when return air is transferred from space to ceiling plenum in lieu of directly ducting return air from the space.

H. Provide: Furnish and install.

I. Directed: Directed by the Construction Manager.

J. Indicated: Indicated by the Contract Documents.

K. K-Factor: Number of British thermal units of heat transmitted per square foot per degree Fahrenheit temperature difference through a material with flat, parallel sides one inch apart.

L. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

M. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.5 GENERAL SUBMITTAL REQUIREMENTS

A. Refer to Division 01 for requirements.

B. After receiving approval of equipment manufacturers and prior to delivery of material to the job site, submit for approval drawings or cuts showing construction size, arrangement, operating clearances, performance characteristics and capacity of materials and equipment. Each item of equipment proposed shall be a standard catalog product of the approved manufacturer.

C. Samples, drawings, specifications, catalogs, etc., submitted for approval shall be properly labeled indicating specific service for which material or equipment is to be used.

D. For systems included in the Commissioning Process provide one additional copy of the submittal for the Commissioning Agent.

1.6 SUBMITTALS

A. Product Data: For the following:
1. Dielectric fittings.

B. Welding certificates.

C. Qualification Data: For installer.

D. Manufacturer's List: Within 15 days after award of the Contract, submit to the Architect for approval, a list of manufacturer's names of material and equipment he or she proposes to provide. In the event any item of material or equipment contained in the list fails to comply with the specification requirements, such item will be rejected. If, prior to the expiration of the fifteen (15) day period or any duly authorized extension thereof, the Contractor fails to submit a schedule of acceptable material or equipment covering the items, the Architect will select the items; such selection shall be final and binding upon the Contractor as a condition of the contract. Rejected items shall be resubmitted within 15 days or the Architect will select such materials and equipment.

E. Access Door Locations: Submit access door locations to the Architect for approval. Equipment requiring access doors shall not be installed prior to approval of access door locations.

F. Coordination Drawings:

1. Provide coordination drawings in accordance with Division 01 Section "Project Management and Coordination". Provide coordination drawings detailing the work in the entire area of work.
2. Building Information Modeling (BIM): Screen captures from BIM software in addition to the electronic file of Revit or Navisworks model are acceptable
3. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components (i.e. electrical, plumbing, sprinkler, structural and architectural work). Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:

a. Planned piping layout, including valve and specialty locations and valve-stem movement.
b. Clearances for installing and maintaining insulation.
c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
d. Equipment and accessory service connections and support details.
e. Fire-rated wall and floor penetrations.
f. Sizes and location of required concrete pads and bases.
g. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.

h. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
i. See Division 23, Section “Metal Ducts” for ductwork installation drawing requirements.
j. Reflected Ceiling Plans:

1) Ceiling suspension assembly members.
2) Other systems installed in same space as ducts.
3) Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4) Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5) Refer to architectural ceiling plans for additional requirements.

G. Field quality control test reports.

H. Operation and Maintenance Data:

1. Operation and maintenance manuals and record product data as specified in Division 01 Section “Operation and Maintenance Data.”
2. Bound sets of approved submittals for items utilized on the project. Manufacturers' advertising literature or catalogs will not be acceptable for operating and maintenance instructions.

I. Record Documents: Refer to Division 01 Section “Project Record Documents” for general requirements.

1.7 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Give necessary notices and obtain required permits. Pay fees and other costs, including utility connections or extensions in connection with the work. File necessary plans, prepare documents and obtain necessary approvals of governmental agencies having jurisdiction. Obtain required certificates of inspection and deliver same to the Architect before request for acceptance and final payment for the work.

E. Materials furnished and work installed shall comply with the latest issue of the codes, rules, regulations, and recommendations.

F. Subcontractor Qualifications:

1. A mechanical contractors shall be a District of Columbia licensed HVACR Master or Master Restricted contractor who is qualified in the areas of work included in the Project.
2. The successful contractor shall agree to employ only individuals who hold valid licenses issued by the District of Columbia HVACR Board of the Department of Labor, Licensing and Regulation to provide, or assist in providing, heating ventilating, air conditioning, or refrigerating system installation or service required for the project.
3. If the successful contractor subcontracts any or all of the heating, ventilating, air conditioning, or refrigerating system installation or service required for a project, the subcontractor must possess the appropriate license required and issued by the District of Columbia HVACR Board.
4. All heating, ventilating, air conditioning, and refrigerating system subcontractors shall consistently use only individuals who hold the appropriate licenses issued by the District of Columbia HVACR Board to provide or assist in providing heating, ventilating, air conditioning, and refrigerating system installation or service required for a project.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 01 Section “Product Requirements” for general requirements.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

D. Proper and suitable tools, equipment and appliances for the safe and convenient handling and placing of materials and equipment shall be used. During loading, unloading, and placing, care shall be taken in handling the equipment and materials so that no equipment or materials, including Owner furnished, are damaged.

E. Mechanical equipment delivered to the job site shall be stored under roof or other approved covering, on pedestals above the ground. Enclosures for equipment shall be weatherproof. Any motors involved in the work that are not totally enclosed and electrical/electronic components shall be stored in a heated area with a minimum temperature of 10 deg. C (50 deg. F). Valves shall be stored under roof on wood pedestals above ground. Pipe for project use shall be stored above grade and in such a manner to prevent entrance of foreign materials. Pipe shall be fitted with end caps or seals to prevent moisture and debris from entering pipe. Insulation shall be stored under roof or in trailers, adequately protected from the weather. Follow written instructions and recommendations of the manufacturer and requirements of the Architect in lubrication, protection and maintenance of equipment during storage.

F. If materials or equipment are found to be in poor condition at the time of being installed, the Architect may, at his discretion, order the Contractor to furnish and install new equipment or materials at no cost to the Owner.

1.9 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.10 EQUIPMENT START-UP AND INITIAL OPERATION

A. See Division 01 Section ”General Commissioning Requirements” for general requirements.

B. No equipment shall be operated for testing or trial use until there has been full compliance with the equipment manufacturers' specifications and instructions for lubrication, alignment, direction of rotation, balance, and other applicable considerations.

C. Particular care shall be taken to verify that equipment is completely assembled and properly lubricated, and grease and oil cases and reservoirs have been filled to the correct level with the recommended lubricant.

D. Where specified, provide services of the manufacturer or his authorized representative to witness, supervise, or assist in the installation and start-up of equipment provided under this Division.

1.11 WARRANTY

A. See Division 01 and General Conditions for general requirements.

B. Provide service of the equipment manufacturer or his authorized representative, if required to achieve specified performance of equipment provided.

C. During the warranty period, service equipment provided except filter replacement and belt replacement. Provide labor and materials in accordance with manufacturer's written instructions for service and maintenance. Prior to the start of warranty period, provide to the Architect for approval, a schedule of required maintenance operations to be performed during the warranty period and required periodically thereafter for each system and item of equipment. Thereafter, monthly reports shall be submitted to the Owner for describing actual service performed. Forty-eight (48) hours advance notice shall be given to Owner prior to work required.

1.12 DRAWINGS

A. The contract drawings are diagrammatic and indicate the general arrangements of systems and work included in the Contract. Do not scale the drawings. Consult the architectural and structural drawings and details for exact location of structure and equipment; where same are not precisely located, obtain this information prior to start of work.

B. Layout of equipment indicated on drawings shall be checked and compared against drawings of trades, and exact locations and clearances for servicing determined using approved shop drawings of such equipment. Where the equipment furnished differs in physical character from that specified or indicated or where physical interference occurs, consult with Architect as to proper location of equipment. Prepare and submit for approval dated and dimensioned drawings correcting such interferences.

C. Although the location of materials and equipment may be shown on the drawings in a certain place, the construction may develop conditions that render this location inaccessible or impractical. In such cases, before fabricating and installing the work, the Contractor shall call the condition to the attention of the Architect for direction. When requested by the Architect a detailed drawing of the proposed departure due to field conditions, or their causes, shall be submitted by the Contractor for approval. The Architect shall make final written decisions as to the conditions, which require the changing of work.

1.13 RECORD DRAWINGS

A. See Division 01, Section “Project Record Documents” and “Closeout Procedures” for general requirements.

B. Carefully record the actual locations of each piece of concealed equipment, control devices, pipe, valves, ducts, terminal units, etc., including dimensions to locate underground work, and work when different from the contract drawings.

1.14 OPERATING AND MAINTENANCE INSTRUCTIONS

A. See Division 01, Section “Closeout Procedures” and “Demonstration and Training” for general requirements of demonstration and training. Refer to Division 01 Commissioning Sections for additional requirements.

B. Upon completion of work and of tests, furnish the necessary skilled labor and helpers for operating and demonstrating the systems and equipment.

C. The instructor shall be thoroughly familiar with parts of the installation on which he is to give instruction and shall be trained in operating theory as well as practical operation and maintenance work. Employ factory trained instructors wherever necessary and as specified.

1. Provide Owner with a DVD recording of the instruction sessions.

D. Instructions shall include a general description of each system together with specific instructions describing routine and emergency procedures required of the building personnel for operating and maintaining each system. The instructions shall include the name or label, location, and function of operating equipment and controls. Operating modes and the procedures for indexing each mode shall be clearly described. Include lubrication charts and schedules of frequency of lubrication for equipment, designating each point of lubrication and type of lubricant to be used. Listings of names, addresses, and phone numbers of the service organizations for each item of equipment and a typewritten maintenance schedule for same shall be included.

E. Provide multiple sessions for the same equipment as required to accommodate quantity of attendees or different work shifts, coordinate with COTR.

F. Provide operation and maintenance manuals and record product data as specified in Division 01, Section “Project Record Documents.”

1. Submit Division 23 operation and maintenance manuals nine months prior to substantial completion.

1.15 FIRE PROTECTION

A. See Division 01 Section “Temporary Facilities and Controls” for general requirements.

B. As minimum, one five-pound CO_2 extinguisher shall be provided with each work crew.

1.16 SEQUENCING AND SCHEDULING

A. See Division 01 Section “Summary” for general requirements.

1.17 SINGULAR NUMBER

A. See Division 01 for general requirements.

B. Where any device or part of equipment is herein referred to in the singular number, such as "valve", such reference applies to as many such devices as are required to complete the installation, shown, implied or otherwise, as indicated on the drawings.

1.18 ACOUSTICAL PERFORMANCE

A. It is the intent of this specification that noise levels from HVAC equipment (air-conditioning and/or ventilating equipment, ducts, grills, diffusers, mixing boxes, fan coil units.) will not exceed the Preferred Noise Criteria Curves (PNC) described in Table 1 below. Preferred Noise Criteria Curves establish a one number rating for evaluating the acceptability of a sound pressure spectrum according to the average person's hearing.

B. These PNC levels should be used as a guide in the event of product substitutions and shop drawing modifications. The PNC levels shall also serve as a gauge by which the results of workmanship and care of installation will be judged from an acoustical standpoint, since a poor installation can lead to the generation of noise.

C. Noise Criteria for occupied spaces for this project shall be set as follows:

Table 1 - Background Noise Design Criteria

Sound Rated Spaces	NC rating
Command Center	NC-30
Classroom	NC-30
Offices/OPS Suite	NC-30

D. In addition to complying with all pertinent codes and regulations, all Division 22, 23, and 26 work shall conform with:
1. ARI Standard 260 Sound Rating of Ducted Air Moving and Conditioning Equipment ARI Standard 280 Requirements for the Qualification of Reverberant Rooms in the 63Hz Octave Band

2. ARI 890/ASHRAE 70-91 Rating of Air Diffusers and Air Diffuser Assemblies
3. ARI Standard 885-90 Method for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
4. AHRI Standard 220 Reverberation Room Qualification and Testing Procedure for Determining Sound Power of HVAC Equipment.
5. ASHRAE Standard 68-86 / AMCA Standard 330-86 Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
6. ASTM C423-90 a Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
7. ASTM E90-09 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
8. ASTM E413-87 Classification for Determination of Sound Transmission Class (STC).
9. ASTM E795-92 Practices for Mounting Test Specimens During Sound Absorption Tests.
10. ISO Standard 9614, Parts 1 and 3 Acoustics, Determination of sound power levels of noise sources using sound intensity – Part 1: Measurement at discrete points ad Part 2: Measurement by scanning.
11. ANSI - S12.2 - 2008: Room Noise, item 5.1.2 Measurements.
12. ASTM E-477 Standard Test Method for Laboratory Measurements of Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. General:

1. Bolting of piping components shall be accomplished with bolts, nuts, and gaskets suitable for the service conditions to be encountered in accordance with proven industry standards. Notify COTR prior to installation of work, if materials noted herein are at variance with above.
2. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. Gaskets for steam and condensate service shall be suitable for operating conditions of 121 to 186 deg C at 1,034 kPa (250 to 366 degrees F at 150 psig). Gaskets shall be spiral-wound with a preformed Type 304 stainless steel strip and a filler material consisting of 99.9 percent carbon, with no binder, respirable fibers, lubricant or other additive, nominal thickness 4.4 mm, and 3.2 mm (0.175-inch, and 0.125-inch) carbons steel outer ring. Gaskets shall be Flexitallic Model CG with flexicrab filler material or approved equal.
2. Gaskets for water services shall be suitable for operating conditions of 4 to 82 deg C at 1,034 kPa (40 to 180 degrees F at 150 psig). Gaskets shall have 1.6 mm (1/16-inch) thickness and be as manufactured by Thermoseal, Model KLINGER-sil C-6400 or approved equal.
3. Flange gaskets for dielectric connections shall be one-piece factory cut insulating gaskets between flanges and be constructed of ASTM D 229 electrical insulating material of 1000 ohms minimum resistance. Provide silicon-coated fiberglass insulating sleeves between the bolts and the holes in flanges; bolts may have reduced shanks of a diameter not less than the diameter at the root of threads. Provide 3.2 mm (0.125 inch) thick high-strength insulating washers next to flanges and provide stainless steel flat circular washers over insulating washers and under bolt heads and nuts. Provide bolts 13 mm (0.5 inch) longer than standard length to compensate for the thicker insulating gaskets and the washers under bolt heads and nuts.
4. Flange Connections: Flange bolts and studs to conform to ASTM A 307, Grade B; and materials for nuts shall conform to ASTM A 194/A 194M, Grade 2. Dimensions of bolts, studs, and nuts shall conform to ANSI B18.2.1 and ASME/ANSI B18.2.2 with threads conforming to ASME B1.1 coarse type, with Class 2A fit for bolts and studs, and Class 2B fit for nuts. Bolts or bolt-studs shall extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Carbon steel bolts shall have American Standard regular square or heavy hexagon heads and shall have American Standard heavy semi-finished hexagonal nuts, conforming to ANSI B18.2.1 and ASME/ANSI B18.2.2.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 PIPING FLEXIBLE CONNECTORS

A. Rubber Flexible Connectors are specified in Division 23 Section “Vibration Controls for HVAC.”

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.
2. Description:
a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 1035 kPa (150 psig) minimum at 82 deg C (180 deg F).
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. CTS.
e. Pipeline Seal and Insulator, Inc.
2. Separate companion flanges and steel bolts and nuts shall have 1,035 kPa (150-psig) minimum working pressure where required to suit system pressures.
3. Description:
a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 1035 kPa. (150 psig).
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 2,070 kPa (300-psig) minimum working pressure at 107 deg C (225 deg F).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Calpico, Inc.
b. Lochinvar Corp.

F. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Grinnell Mechanical Products.
   b. Perfection Corp.
   c. Precision Plumbing Products, Inc.
   d. Sioux Chief Manufacturing Co., Inc.
   e. Victaulic Co. of America.
2. Description:
   a. Standard: IAPMO PS 66.
   b. Electroplated steel nipple, complying with ASTM F 1545.
   c. Pressure Rating: 2070 kPa (300 psig) at 107 deg C (225 deg F)
   d. End Connections: Male threaded or grooved.
   e. Lining: Inert and noncorrosive, propylene.

2.6 DRIVES FOR MACHINERY

A. Equip each motor driven machine with a V-belt drive except those that are directly connected. Factory designed and assembled belt drives that do not conform to the following will be rejected.

B. Select each drive according to the rating and recommendation of the manufacturer (and as specified in other Sections) for the service with which used, giving proper allowance for sheave diameter, center distance, and arc of contact.

C. Belts shall be constructed of endless reinforced cords of long staple cotton, nylon, rayon, or other suitable textile fibers imbedded in rubber. Use belts having correct cross section to fit properly in the sheave grooves. Carefully match belts for each drive.

D. Unless otherwise specified, motor sheaves shall be adjustable pitch type so selected that the required fan rotation speed will be obtained with the motor sheave set approximately in mid-position and have the specified pitch diameter in that position.

   1. Motors driven by variable frequency controllers or electronically commutated motors shall utilize fixed pitch type.

E. Select the motor of a capacity needed to operate the equipment at the specified mid-position operating condition, and so that they have a nameplate rating of not less than 10 percent greater than the total of actual fan brake horsepower and drive loss at specified capacity. Where non-overloading of the motors is specified, select the motor capacity rating at closed position of the motor sheave. In no case shall motors be a smaller size than those scheduled.

F. Do not select fan sheave smaller in diameter than 30 percent of the fan wheel diameter.

G. Construct sheave of cast iron or steel, bored to fit properly on the shafts and secured with key ways of proper size, except that set screws may be used for sheaves having 13 mm (1/2-inch) or smaller bores.

H. Provide OSHA approved guards for belt drives, with instrument openings at the fan and motor sheaves, constructed in accordance with SMACNA standards, ANSI B15.1, and OSHA 29 CFR 1910.219. Submit shop drawings for approval.

2.7 MOTOR STARTING EQUIPMENT

A. Unless otherwise specified, motor control centers, starters, disconnect switches, combination starters and disconnect switches and variable frequency controllers shall be provided by the Division 26 Contractor, except for packaged equipment as specified under this Division.

B. Magnetic motor starters and combination starters, which are integral part of the equipment, shall be furnished by the Division 23 Contractor. Refer to Division 26 Section “Enclosed Switches and Circuit Breakers” for requirements.

2.8 DRIP PANS

A. Where possible to run mechanical piping elsewhere, do not run mechanical piping directly above electrical (or electronic) equipment; otherwise provide drip pans under mechanical piping, sufficient to protect electrical work from drips, and where indicated on details. Locate pan immediately below piping, and extend a minimum of 150 mm (6 inches) on each side of piping and lengthwise 460 mm (18 inches) beyond the protected equipment. Fabricate pans of reinforced metal 50 mm (2 inches) deep, with rolled edges and soldered or welded seams; metal shall be 20 gage copper, or 18 gage steel with 600 gram per square meter (2 oz. per square ft) zinc finish hot dipped after fabrication. Slope pan towards drain outlet. Provide DN 20 (NPS 3/4) copper drainage piping, discharging to nearest floor drain, service sink, or as directed.

2.9 GROUT

A. Interior wet-applied adhesives, paints, and coatings: Comply with low-emitting requirements in Division 01 Section “Sustainable Design Requirements”.

B. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 34.5 MPa (5000-psi), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.10 PACKING MATERIAL FOR PENETRATIONS

A. Mineral fiber; non-combustible; resistant to water, mildew, and vermin. Minimum density shall be 64 kg/cu m (4.0 lbs/cu ft). Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 64-kg/cu m (4.0-lb/cu ft).

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction

loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved by the COTR.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Penetration Firestopping" for materials.

M. Verify final equipment locations for roughing-in.

N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

O. Refer to installation details on drawings for additional requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping DN 50 (NPS 2) and smaller, adjacent to each control valve and at final connection to each piece of equipment.
2. Install flanges, in piping DN 65 (NPS 2-1/2) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric flanges, coupling, and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations. In no case shall equipment be installed with service clearance less than manufacturer’s recommendations.

D. Install equipment to allow right of way for piping installed at required slope.

E. Refer to installation details on drawings for additional requirements.

3.5 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09 Section ”Painting and Coating.”

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish. Provide complete new finish if, in the opinion of the Architect or COTR, the factory finishes are severely damaged.

1. Touch up threads of zinc coated screwed pipe with Rustoleum primer and one coat of enamel conforming to painting specification.
2. Refer to Division 23 Section “Metal Ducts” for painting requirements behind grilles and registers.
3. Prepare piping and ductwork and associated hangers specified to be painted to accept field paint.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF TEMPORARY WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 WORKMANSHIP

A. Furnish the services of an experienced full time field superintendent who shall be constantly in charge of the installation of the work provided under this Division. Superintendent shall have demonstrated experience with projects of comparable size and complexity and shall be approved by the Architect.

B. The quality of workmanship required in the execution of the work shall be the finest and highest obtainable, working with the materials specified. Workmanship shall be satisfactory to the Architect and his decision as to acceptable quality is final.

3.10 EQUIPMENT CONNECTIONS

A. Equipment shall be installed and connected in accordance with the best engineering practice and in accordance with manufacturer's instructions and recommendations. Auxiliary piping, valves, and electric connections recommended by the manufacturer or required for proper operation shall be provided.

B. See Division 26 for electrical power wiring and final connections to motors and equipment requiring electric service. Temperature control wiring between starters and controlling devices and interlock wiring are specified in Division 23, Section “Direct Digital Controls (DDC) for HVAC”. Verify that the proper power wiring services are installed prior to starting the equipment specified in Division 23.

3.11 CUTTING AND PATCHING

A. See Division 01 for general requirements.

B. Cutting and patching of building materials shall be performed in a neat and workmanlike manner. Surfaces, which are damaged by the Contractor, shall be repaired or provided with new materials. Patching and materials shall be done with materials and methods similar to adjacent work, subject to approval of the Architect. Structural members shall not be cut or penetrated unless indicated on the drawings and verified in the field with the Construction Manager. Holes cut through concrete and/or masonry to accommodate work under this Division shall be cut by reciprocating or rotary non-percussive methods.

3.12 SURVEYS AND MEASUREMENTS

A. Base measurements, both horizontal and vertical, from established benchmarks. Work shall agree with these established lines and levels. Verify measurements at site and check correctness of same as related to the work.

B. Should the Contractor discover any discrepancy between actual measurements or conditions, and those indicated which prevent following good practice or the intent of the drawings and specifications, he shall notify the Construction Manager and shall not proceed with his work until he has received instruction from the Construction Manager.

3.13 RIGGING OF EQUIPMENT

A. Verify that rigging path for equipment prior to start of work or ordering of materials. Verify accessways and weight carrying capacity of building features, including elevators, floors, walls, ceilings, roofs, and related features. When equipment or sections of equipment are larger than available accessways, equipment shall be ordered in a knocked-down configuration for re-assembly at the site. Submit in writing to Architect where problems are encountered that may prohibit rigging of equipment into space with the proposed solutions.

B. Use planking or cribbing as required to protect adjoining construction from damage. Protect equipment from damage until construction is completed.

3.14 WELDING

A. Welding piping shall comply with the provisions of the latest revision of the ASME Code for Pressure Piping, ANSI/ASME B31.1 - Power Piping, and ANSI/ASME B31.9 - Building Services Piping. Contractor shall comply with requirements of federal, state or local agencies having legal jurisdiction that are more stringent than the above ANSI/ASME Codes.

B. State, county, and city fire prevention code requirements, fire and safety regulations, and NFPA 241 shall be complied with, including the provision of appropriate portable fire extinguishers. Prior to performing welding within the building, notify the Construction Manager in advance of areas where welding will occur, and submit for approval a plan for protection of the building and occupants. Proceed only upon receipt of Construction Manager's approval and provide reasonable barriers, coverings, etc., as required or requested by the Construction Manager for protection of the installed work and building occupants. In regards to welding operations within the building, maintain a negative pressure within the work area to prevent the migration of smoke and fumes to occupied areas of the building. Provide temporary exhaust fans and smoke removal systems as required - discharge of smoke and fumes shall be to the building exterior in a manner to not be recirculated back into building through areaways, windows, etc. and away from public accessways.

C. Provide single-vee type butt welds, unless specified otherwise. Joint configuration shall conform to ANSI B16.25.

D. Before welding is performed, submit a copy of the Contractor's Standard Welding Procedure Specification for shop and field welding together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code.

E. Before a welder shall perform welding, submit a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests as required by Section IX of the ASME Boiler and Pressure Vessel Code.

F. Welds shall have penetration complete to the inside diameter of the pipe and the recommended spacing and bevels between ends of pipe prior to welding shall be used to assure full penetration for pipe service conditions of 177ºC (350ºF) and above (e.g. all medium pressure steam piping). Weld penetrations for pipe service conditions less than 177ºC (350ºF) shall be in accordance with the applicable ANSI/ASME Code.

G. Inspection of shop welding facility and visual and nondestructive testing of sample shop welds shall be performed to detect the surface and internal discontinuities in completed welds by an independent testing agency hired by the Construction Manager.

H. Visual and nondestructive examinations of field welds shall be performed to detect the surface and internal discontinuities in completed welds by an independent testing agency hired by the Construction Manager. Welds performed in a pre-fabrication shop do not require independent testing agency inspections. The Contractor shall fully cooperate with an independent testing agency so that welds can be examined by the independent testing agency. The types and extent of non-destructive examinations required for pipe welds are as shown in Table 136.4 of ASME Code for Pressure Piping, ANSI/ASME B31.1-Power Piping and as contained herein. If requirements for visual and nondestructive examinations are to be other than contained herein, the degree of examination and basis of rejection shall be a matter of prior written agreement

between the Construction Manager and the independent testing agency. The extent of visual and non-destructive examinations shall be as follows:

1. The independent testing agency shall test a minimum of 10% of the total length or number of piping field welds by utilizing radiograph, ultrasonic testing, sectioning or a combination of these methods as determined by the independent testing agency. If a random weld test reveals that a weld fails to meet the minimum quality requirements, an additional 10 percent of the field welds in that same group shall be tested at the Contractor's expense and at no additional cost to the Owner. If the additional field welds examined meet the quality requirements, the entire group of welds represented shall be accepted and the defective welds shall be repaired. If any of the additional field welds examined also fail to meet the quality requirements as determined by the independent testing agency, that entire group of field welds shall be rejected. Remove and re-weld rejected welds or examine rejected field welds (at the Contractor's expense and at no additional cost to the Owner) and remove and re-weld defects.

2. Field welds shall be visually examined as follows:

    a. Before welding -- for compliance with requirements for joint preparation, placement of backing rings or consumable inserts (if used), alignment and fit-up, and cleanliness.
    b. During welding -- for conformance to the qualified welding procedure.
    c. After welding -- for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

3. Field welds determined to be unacceptable shall be removed and replaced by the Contractor, at no additional cost to the Owner, in accordance with the applicable standards. Repair defects discovered between weld passes before additional weld material is deposited. Wherever a defect is removed, and repair by welding is not required, the affected area shall be blended into the surrounding surface eliminating sharp notches, crevices, or corners. After defect removal is complete and before re-welding, re-examine the area by the same test methods that first revealed the defect to ensure that the defect has been eliminated. After re-welding, re-examine the repaired area by the same test methods originally used for that area. For repairs to base material, the minimum examination shall be the same as required for butt welds. Indication of a defect shall be regarded as a defect unless re-evaluation by non-destructive examination testing or by surface conditioning shows that no unacceptable indications are present. The use of foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

I. Pipe welds shall not be covered prior to examination by the independent testing agency. Should the independent testing agency encounter pipe joints that are covered, Contractor shall remove covering and replace with new covering, at no additional cost to the Owner, following examination by the independent testing agency. Coverings shall include, but not limited to, insulation, jacketing, outer conduit closure kits, special coatings, and backfill. Examinations of welds for the metal conduits for pre-insulated conduit piping systems may be covered without examination by the independent testing agency.

J. Welding at hangers, supports and plates to structural members shall conform to American Welding Society, Inc. AWS D1.1 Structural Welding Code Steel.

K. When requested by the independent testing agency or Architect, submit identifying stenciled test coupons made by any welder in question. The Contractor shall require a welder to retake the tests when, in the opinion of the Architect or independent testing agency, the work of the welder creates a reasonable doubt as to his proficiency. Tests, when required, shall be conducted at no additional expense to the Owner; and the welder in question shall not be permitted to work as a welder on this project until he has been re-qualified.

L. The use of backing rings shall be at the discretion of the installing Contractor provided that the Contractor prepares and aligns pipes precisely to melt through to the inside surface - making a full penetration weld. At the direction of the independent testing agency, the Contractor may be directed to use backing rings (at no additional cost to the owner) when deemed necessary by the independent testing agency after examination of the pipe welds.

M. When weld testing or examination is performed as required herein, the corresponding written certified test reports shall be submitted.

3.15 CLEANING

A. See Division 01, Section “Closeout Procedures.”

B. Thoroughly clean exposed surfaces of equipment and material and leave in a neat, clean condition ready for painting.

C. After completion of installation, thoroughly clean dirt, rust, loose scale, oils and grease, and other foreign matter for work.

D. Clean piping systems thoroughly of grease, metal shavings, welding beads or other refuse.

1. Provide temporary piping and pumps as required to properly flush, clean, and dispose of water from site.

E. Flush systems with new potable water after pressure testing is complete and drain at low points. Continue flushing until water samples taken at low points are clear of visible grease, dirt, and contaminants. Obtain written acceptance from Owner upon completion of flushing acknowledging Owner's acceptance of system cleanliness.

1. Flush Rate: Minimum 3.0 meters per second (10 feet per second).

3.16 PIPING SYSTEMS, GENERAL TESTING

A. Piping systems shall be pressure tested hydrostatically in accordance with applicable codes. Testing shall be done in accordance with the following procedures:

1. Before testing, complete the installation of each pipe line, including supports, hangers and anchors. Perform testing before insulation is field-applied. Clean piping and equipment of metal cuttings and foreign matter as they are installed.
2. Submit test procedures and schedules to the COTR two weeks before testing starts. Test procedures and schedules shall be approved by the COTR. Tests shall be witnessed and approved by the Owner or his designated representative.

3. Codes - Pressure test piping to assure integrity of material and workmanship in accordance with the applicable ANSI/ASME Code for Pressure Piping B31, the Plumbing Code, or NFPA Standards as applicable.
4. Pressure vessels, pumps, rotating and other mechanical equipment shall not be subject to the piping field pressure tests.
5. Equipment, instruments and piping specialties which are not to be included in the test shall be either disconnected from the piping and the end of the pipe blanked off by a blind flange, plug or cap, or isolated.
6. Test the piping in sections or circuits as required for the progress of the work.
7. Systems to be pressurized shall be provided with appropriate gages and pressure-relieving devices.
8. Test pressure readings may be taken at the lowest point in the line or system of lines, provided that the static head is added to the minimum test pressure.
9. Lines containing check valves shall have the source of test pressure located on the high-pressure side of the valves. Line control valves shall be set and maintained in a wide-open position.
10. The Owner may waive a pressure test for any reason. Such waiver shall be noted on the pressure test record.
11. Duration of Test - Maintain the test pressure for a sufficient time but not less than 4 hours to determine and locate any leaks.
12. Records - Provide a record of tests. The record shall show line designation, test pressure, ambient temperature, date of test, retests, and signature of Owner's witness. If either testing or witnessing is waived, a note shall be made for each line so waived.
13. Hydrostatic Test Procedures - Test the piping system hydrostatically in accordance with the requirements of the applicable ANSI/ASME Code for Pressure Piping B31.
14. Repair of Line Leaks - Comply with the following procedures for repair of leaks. In each case, a retest shall be necessary after repairs are made and shall be made at no additional cost to the Owner.

    a. Soldered/Brazed Joints - Remove solder/brazing alloy and reapply with proper flux.
    b. Flanged End Joints - Check to determine flange end alignment and that all bolts are uniformly tightened with the required torque. If leak persists, depressurize the line, remove gasket, examine flange end faces, and insert new gasket.
    c. Threaded Joints - Tighten joint to a reasonable torque. If leak does not stop, replace pipe and/or fittings. Do not use pipe dope or cement to stop pipe leaks.
    d. Gasketed Joints - Remove existing gasket and insert new gasket.
    e. Welded Joints - Replace joint.
    f. Leaks in Material - Leaks located in pipe material shall require the replacement of that section of pipe or fitting and repeat of the test from the beginning. Caulking, welding or epoxy is not permitted. Repair damage caused by leaks. Repairs and retest shall be made at no additional cost to the Owner.

3.17 ACCESSIBILITY

A. Locate equipment that must be serviced, operated or maintained, in fully accessible positions. Equipment shall include, but not be limited to, terminal units, coils, valves, motors, controllers, ATC dampers, drain points, cleanouts, etc. Provide adequate means to access equipment for repair and maintenance including capabilities for platforms, fall protection systems, and anchorage points.

B. Where required or where directed, provide access doors. Locate equipment and associated access doors in accordance with the architectural reflected ceiling plan drawings (not all required access doors are indicated on the plans, only the ones that the Architect has specific requirements for placement). Doors installed in fire-rated walls or shafts shall be labeled and shall match rating of the construction. Doors shall be sufficient size to allow access to components, except minimum size shall be 300 mm x 400 mm (12 inches x 16 inches). Where equipment requires access to various parts, such as air terminal units require access to the controller and valve and piping appurtenances for the reheat coil, locate appurtenances requiring access such that all devices can be maintained from single door. For items that require access greater than 3 feet above the ceiling, provide minimum 1.2 m x 1.2 m (4 feet x 4 feet) removable ceiling panel to facilitate top of a folding ladder placed above the ceiling plane. Access doors are specified in Division 8 Section “Access Doors and Frames.”

C. The Contractor at no expense to the Owner shall rework equipment deemed inaccessible by the Architect.

D. Refer to Division 23 Section “Air Duct Accessories” for access doors installed in ductwork.

3.18 FLASHING

A. See Division 07 sections.

B. Openings for pipes and ductwork through waterproofed roof areas shall be flashed.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section also applies to Division 22 Plumbing Specification Sections.

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.4 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.
5. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

1.5 SUBMITTALS

A. Product Data: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; enclosure type and mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
   1. Each installed unit's type and details.
   2. Nameplate legends.
   3. Diagrams of power, signal, and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.

C. For each motor or motor-driven equipment including at least the following:
   1. Unit or motor data defining efficiency and power factor at incremental loads (10% or smaller increments) from full load to no load without power factor correction.
   2. Maximum allowable power factor correction capacitance which will not cause over-excitation at no load.
   3. Data on each component used to achieve required power factor correction.
   4. Data to enable calculation of motor load at design duty.
   5. Value of Full Load Amperes (FLA) with correction capacitance provided and connected.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 1000 m (3300 feet) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Motors 1/2 HP and Larger: Three phase.

D. Motors Smaller Than 1/2 HP: Single phase.

E. Frequency Rating: 60 Hz.

F. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

G. Service Factor: 1.15 for open drip proof motors; 1.0 for totally enclosed motors.

H. Enclosure:
1. Outside of Airstream: Open drip proof, unless indicated otherwise.
2. Within Airstream: Totally enclosed, fan cooled.

I. Speed: 1750 RPM, unless indicated otherwise.

2.3 Noise: Comply with maximum recommended IEC Standards (Tables B and C), and NEMA limits based on motor frame size, speed, and enclosure type, except maximum overall sound pressure levels shall not exceed 90 dBA as measured 1 m (3 feet) from motor, and throughout its operating range from no load to full nameplate rating, and 15% speed to maximum speed to comply with CFR Title 41, Part 50-204.10.POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage, unless otherwise indicated.

F. Stator: Copper windings, unless otherwise indicated.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Class B.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

1. Finish: Enamel.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
4. Shaft: Carbon steel.
5. Shaft Grounding: Provide shaft grounding brush equal to Aegis SGR™ Conductive Microfiber™ on drive end (between motor and shaft coupling to driven equipment).
6. Insulated Bearings: For 40 HP and larger, provide insulated type ceramic motor bearings on non drive end, opposite shaft grounded end.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

D. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Electronically commutated.
3. Split phase.
4. Capacitor start, inductor run.
5. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor or electronically commutated type.

C. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated – sleeve type for other single-phase motors.

D. Shaded-Pole Type Motors: For motors 1/20 HP and smaller only.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 ELECTRONICALLY COMMUTATED MOTORS (ECM)

A. Description: Variable-speed, direct current (DC), brushless motors, with integral controller that operates the wound stator and senses rotor position to electronically commutate the stator.
1. Phase: Single or polyphase, as indicated on drawings.

2. Rotation: Synchronous, designed to overcome reverse rotation.
3. Rotor: Permanent magnet, with zero losses.
4. Ramping: Soft-start and soft speed change.
5. Mounting: Horizontal or vertical shaft.
6. Bearings: Ball type, permanently lubricated.
7. Efficiency: Higher than specified for AC motors.
8. Controller: Pulse width modulation type, factory installed, preset to scheduled flow.
    a. Input Current: Alternating Current.
    b. Output Current: Direct current.
    c. Harmonic Filtration: Inductors.
    d. Field adjustment of motor speed set point via the following:
        1) Manual adjustment.
        2) Remote 0-10 volt dc signal from BAS,
    e. Remote Start/Stop Signal: Binary, from BAS.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section also applies to Division 22 Plumbing Specification Sections.

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section Includes:

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

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Vibration Controls for HVAC" for vibration isolation devices.
3. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.4 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.5 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, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.6 ACTION SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

1.7 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

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

B. Copper Pipe Hangers:

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

2.2 TRAPEZE PIPE HANGERS

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

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. B-line, an Eaton business.
   b.
   c. Thomas & Betts Corporation; A Member of the ABB Group.
   d. Unistrut; Part of Atkore International.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. ERICO International Corporation.
3. National Pipe Hanger Corporation.
4. PHS Industries, Inc.
5. Pipe Shields Inc.
6. Piping Technology & Products, Inc.
7. Rilco Manufacturing Co., Inc.
8. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 688-kPa (100-psig) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 688-kPa (100-psig) ASTM C 552, or Type II cellular glass with 688-kPa (100-psig) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 50 mm (2 inches) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or 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.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

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

2.8 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: 34.5-MPa (5000-psi), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
1. Size hangers and supports to match OD of pipe insulation.

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.
3. Size hangers and supports to match OD of pipe insulation.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping. Use of wood blocks as a substitute for thermal-hanger shield inserts is not acceptable.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 100 mm (4 inches) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.
3. Use of pipe stands in mechanical equipment rooms is prohibited without written approval from COTR

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal 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.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, DN 65 (NPS 2-1/2) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. 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 DN 100 (NPS 4) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe DN 100 (NPS 4) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. DN 8 to DN 90 (NPS 1/4 to NPS 3-1/2): 305 mm (12 inches) long and 1.22 mm (0.048 inch) thick.
    b. DN 100 (NPS 4): 305 mm (12 inches) long and 1.52 mm (0.06 inch) thick.
    c. DN 125 and DN 150 (NPS 5 and NPS 6): 457 mm (18 inches) long and 1.52 mm (0.06 inch) thick.
    d. DN 200 to DN 350 (NPS 8 to NPS 14): 610 mm (24 inches) long and 1.91 mm (0.075 inch) thick.
    e. DN 400 to DN 600 (NPS 16 to NPS 24): 610 mm (24 inches) long and 2.67 mm (0.105 inch) thick.

5. Pipes DN 200 (NPS 8) and Larger: Include reinforced insulation inserts of length at least as long as protective shield.
6. 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 40 mm (1-1/2 inches). Provide plastic caps on exposed ends of hanger and support rods that are within 80 inches of floor level.

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 0.05 mm (2.0 mils).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 Section "Interior Painting"

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. Size hangers and supports to match OD of pipe insulation.

B. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

C. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

D. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

E. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

F. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing. Wood block inserts are not acceptable**.**

J. 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 DN 15 to DN 750 (NPS 1/2 to NPS 30).

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 566 deg C (1050 deg F), pipes DN 100 to DN 600 (NPS 4 to NPS 24), requiring up to 100 mm (4 inches) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes DN 20 to DN 900 (NPS 3/4 to NPS 36), requiring clamp flexibility and up to 100 mm (4 inches) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes DN 15 to DN 600 (NPS 1/2 to NPS 24) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes DN 15 to DN 100 (NPS 1/2 to NPS 4), to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes DN 20 to DN 200 (NPS 3/4 to NPS 8).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes DN 15 to DN 200 (NPS 1/2 to NPS 8).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes DN 15 to DN 200 (NPS 1/2 to NPS 8).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes DN 15 to DN 200 (NPS 1/2 to NPS 8).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes DN 10 to DN 200 (NPS 3/8 to NPS 8).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes DN 10 to DN 80 (NPS 3/8 to NPS 3).
12. U-Bolts (MSS Type 24): For support of heavy pipes DN 15 to DN 750 (NPS 1/2 to NPS 30).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes DN 100 to DN 900 (NPS 4 to NPS 36), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes DN 100 to DN 900 (NPS 4 to NPS 36), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes DN 65 to DN 900 (NPS 2-1/2 to NPS 36) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes DN 25 to DN 750 (NPS 1 to NPS 30), from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes DN 65 to DN 600 (NPS 2-1/2 to NPS 24), from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes DN 50 to DN 1050 (NPS 2 to NPS 42) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes DN 50 to DN 600 (NPS 2 to NPS 24) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes DN 50 to DN 750 (NPS 2 to NPS 30) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. 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 DN 24 to DN 600 (NPS 3/4 to NPS 24).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers DN 20 to DN 600 (NPS 3/4 to NPS 24) if longer ends are required for riser clamps.

L. 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 150 mm (6 inches) for heavy loads.
2. Steel Clevises (MSS Type 14): For 49 to 232 deg C (120 to 450 deg F) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 49 to 232 deg C (120 to 450 deg F) piping installations.

M. 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 340 kg (750 lb).
    b. Medium (MSS Type 32): 680 kg (1500 lb).
    c. Heavy (MSS Type 33): 1360 kg (3000 lb).

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. 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.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 32 mm (1-1/4 inches).
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section also applies to Division 22 Plumbing Specification Sections.

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section includes vibration isolation for equipment, piping, and ductwork:

1. Vibration isolators for Piping Ductwork and Equipment
2. Flexible Piping Connections
3. Resilient Piping Connections

B. Mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on or suspended from vibration isolators to reduce the transmission of vibration and mechanically transmitted sound to the building structure.

C. Refer to ASHRAE Guidelines on Vibration Isolation in the 2015 ASHRAE Handbook- HVAC Applications, Chapter 48, for additional information not covered in this section.

D. Contact the mechanical COTR or acoustical consultant for rotating or vibrating equipment that is not included in this section.

E. Related Sections include the following:

1. Division 23 Section “Common Work Results for Mechanical” for general noise control requirements and listing of noise critical spaces.
2. Division 03 Section “Cast-In-Place Concrete” for concrete.

1.4 QUALITY ASSURANCE

A. Manufacturer to:

1. Determine vibration isolation sizes and locations.
2. Provide piping and equipment isolation systems as scheduled or specified.
3. Guarantee specified isolation system deflection.

4. Provide installation instructions and drawings.
5. Coordinate with the supporting steel structure and installation details.
6. Substitution of “Internally Isolated” mechanical equipment in lieu of the specified isolation of this section must be approved for individual equipment units by the acoustical consultant. This type of substitution will only be considered with a letter of guarantee from the equipment manufacturer that states that the “Internal Isolated” mechanical equipment is equivalent to the specified isolation outlined in this section.

1.5 SUBMITTALS

A. Product Data: Submit the following data for approval, clearly identifying each item of equipment supported and the isolation to be installed at each point of support:

1. Summary sheet of equipment supported and the isolation to be installed at each point of support. The following items shall be provided on the summary sheet.

a. Location
b. Estimated load
c. Type by model number
d. Number of isolators
e. Rated capacity (kg) (lbs.)
f. Rated static deflection (mm) (in.)
g. Estimated deflection under estimated load (mm) (in.)

2. Dimension detail for each isolation device.
3. Piping and duct layout drawings showing each point of support and isolator type selected by model number and spring color reference to summary sheet.
4. Horsepower of each motor, and rpm of both driven and driver, in each supported unit.
5. Static deflection as indicated in the Vibration Isolation Schedule herein, in mm and inches.
6. Scheduled deflection of each isolator. Identification of each isolator selected by model number and spring color.
7. Deflection of each isolator under the calculated load, actual loaded and unloaded measurable spring height.
8. The loading at which each isolator would be fully compressed to solid.

B. Samples:

1. Provide one sample of each type of vibration isolator in use on the project.

C. Final Inspection Report: Describing findings of inspection.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.

2. Kinetics Noise Control.
3. Mason Industries.
4. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.
2. Thickness: Minimum 5/16 inches.
3. Maximum Durometer: 50.

C. Mounts: Double-deflection type, with molded, oil-resistant neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

a. Maximum Durometer: 70.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Horizontal Thrust Restraints: Modified Spring Isolator, with rod and angle brackets.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Maximum Movement: 1/4-inch from stop to maximum thrust.
3. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
4. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside, with integral neoprene bushing and precompression stop nut.
5. End Plate and Adjustment Bolt: Threaded end plate with adjustment bolt and cap screw.
6. Deflection: Match spring isolators.

G. Elastomeric Hangers: Double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
3. Maximum Durometer: 70.

H. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

K. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

L. Resilient Washer-Bushings: Molded, oil resistant bridge bearing neoprene.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control.
3. Mason Industries.
4. Vibration Mountings & Controls, Inc.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 FACTORY FINISHES

A. Finish (where field painting of mechanical items is specified in Division 9): Manufacturer's standard prime-coat finish ready for field painting.

B. Finish (where field painting of mechanical items is not specified in Division 9): Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs.
2. All hardware shall be galvanized.
3. Hot-dip galvanize metal components on isolators (except springs) for exterior use.
4. Baked enamel or powder coat for metal components on isolators for interior use.
5. Color-code or otherwise mark vibration isolation and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION-CONTROL DEVICE INSTALLATION

A. Install resilient washer-bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

B. Install resilient washer-bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Adhesive applied within waterproofing envelope: VOC content not to exceed 250 g/L.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

D. Align vibration isolators squarely above or below mounting points of the supported equipment.

E. For equipment with bases, locate isolators on the sides of the base that are parallel to the equipment shaft.

F. Isolator base plates shall rest entirely on the housekeeping pad.

G. Position vibration isolation hangers as high as possible in the hanger rod assembly but not in contact with the building structure. Provide 1-inch minimum clearance between hanger housing and structure above. Provide side clearance for hanger housings to allow a full 360-degree rotation about the rod axis without contacting any object.

H. Parallel pipes may be hung together on a trapeze that is isolated from the structure. Isolator deflections must equal the greatest deflection for those pipes if isolated individually. Do not mix isolated and non-isolated pipes on the same trapeze.

I. Do not hang or support piping, ductwork, conduit or mechanical equipment on other equipment, pipes or ductwork installed on vibration isolators. Maintain 2-inch clearance between isolated equipment and walls, ceilings and other equipment. Do not allow drain piping connected to vibration-isolated equipment to contact the building structure or other non-isolated systems unless it is resiliently mounted.

J. Flexible Ductwork Connectors: Provide flexible ductwork connectors in ductwork at the point where it is connected to externally isolated air handling unit casings, exhaust fans, rooftop exhaust fans, fan coils or any other vibration-isolated equipment. Install these connectors between the equipment and the first associated duct support or hanger.

K. Flexible Piping Connectors: Provide flexible piping connectors in piping where it is connected to vibration-isolated equipment. Install these connectors between the equipment and the first associated pipe support or hanger, except where supports connect to an inertia base common to the equipment.

L. The installation or use of vibration isolators shall not cause any change of position of piping which will result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, maintain equipment and piping in a rigid position during installation. Do not transfer the load to the isolators until the installation is complete and under full operational load.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage the isolator manufacturer or their authorized representative to perform tests and inspections.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, and with at least seven days' advance notice.
3. Test equipment isolators and first four associated vibration isolation hangers from each equipment connection.
4. Measure isolator restraint clearance.
5. Measure isolator deflection.
6. Inspect vibration control devices and remove paint splatters, spots, dirt, and debris.
7. Vibration testing is specified in Division 23 Section “Testing, Adjusting, and Balancing for HVAC.”

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators so that isolated equipment is level and in proper alignment with connecting ducts and pipes.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

E. Attach thrust restraints at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

3.5 HVAC VIBRATION-CONTROL DEVICE SCHEDULE

ITEM DESCRIPTION	ISOLATOR AND BASE TYPE	MIN. STATIC DEFLECTION (INCHES)	
		Slab On Grade	Floor Span
DUCTWORK			
First two supports near equipment isolated with springs	Spring Hangers (suspended); Spring Isolators (floor mounted)	(Note 2)	(Note 2)
First two supports near equipment isolated with pads and mounts, and non-isolated equipment	Elastomeric Hangers (suspended); Isolation Mounts (floor mounted)	0.35	0.35
After first two supports, within 50 feet of isolated equipment, or within mechanical room (whichever is greater)	Elastomeric Hangers (suspended); Isolation Mounts (floor mounted)	0.35	0.35
Connections to externally isolated equipment	Flexible Duct Connectors and Horizontal Thrust Restraints	(Note 2)	(Note 2)
Connections to internally isolated equipment without integral flexible duct connectors	Flexible Duct Connectors and Horizontal Thrust Restraints	(Note 2)	(Note 2)
FANS			
Suspended, up to 22-inch diameter	Spring Hangers	--	0.75
Suspended, above 22-inch diameter	Spring Hangers	--	(Note 1)
FAN RPM SCHEDULE			
Up to 300 RPM	--	2.5	3.5
301 – 500 RPM	--	1.5	2.5
501 RPM and above	--	1.0	1.5
SUSPENDED COMPUTER ROOM AIR CONDITIONING UNITS	Spring Hangers	--	0.75

NOTES:
1. Refer to Fan RPM Schedule for minimum static deflection. Select deflection based on minimum speed (rpm) anticipated for fans with variable frequency controllers or multi-speed motors
2. Static deflection equal to the isolators supporting the equipment.

END OF SECTION 230548.13

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section also applies to Division 22 Plumbing Specification Sections.

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Warning tags.

B. Related Sections include the following:

1. Division 01 Sustainability Sections for additional requirements related to the LEED certification process.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 ADHESIVE REQUIREMENTS

A. Interior Wet-Applied Adhesives, Paints, Coatings: Comply with low-emitting requirements in Division 01 Section “Sustainable Design Requirements.”

2.2 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Marking Services, Inc.
c. Seton Identification Products.

1. Material and Thickness: Brass, 0.8-mm (0.032-inch); stainless steel, 0.64-mm (0.025-inch), aluminum, 0.8-mm (0.032-inch); or anodized aluminum, 0.8-mm (0.032-inch) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Minimum Label Size: Length and width vary for required label content, but not less than 64 by 19 mm (2-1/2 by 3/4 inch).
5. Minimum Letter Size: 6.4 mm (1/4 inch) for name of units if viewing distance is less than 600 mm (24 inches), 13 mm (1/2 inch) for viewing distances up to 1830 mm (72 inches), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Marking Services, Inc.
c. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 3.2 mm (1/8 inch) thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 71 deg C (160 deg F).
6. Minimum Label Size: Length and width vary for required label content, but not less than 64 by 19 mm (2-1/2 by 3/4 inch).
7. Minimum Letter Size: 6.4 mm (1/4 inch) for name of units if viewing distance is less than 600 mm (24 inches, 13 mm (1/2 inch) for viewing distances up to 1830 mm (72 inches),

and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. 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), and the Specification Section number and title where equipment is specified.

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

2.3 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Seton Identification Products.
3. Stranco, Inc.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 3.2 mm (1/8 inch) thick, and having predrilled holes for attachment hardware.

C. Letter Color: White.

D. Background Color: Black.

E. Maximum Temperature: Able to withstand temperatures up to 71 deg C (160 deg F).

F. Minimum Label Size: Length and width vary for required label content, but not less than 64 by 19 mm (2-1/2 by 3/4 inch).

G. Minimum Letter Size: 6.4 mm (1/4 inch) for name of units if viewing distance is less than 600 mm (24 inches, 13 mm (1/2 inch) for viewing distances up to 1830 mm (72 inches), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.4 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brady Corporation.
   2. Marking Sevices Inc.
   3. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
   1. Rainwater harvesting systems shall be purple in color.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include 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 13 mm (1/2 inch) for viewing distances up to 1830 mm (72 inches) and proportionately larger lettering for greater viewing distances.

F. Pipe Stripes: Vinyl tape, 5 mil thickness, 19 mm (3/4-inch) wide.
   1. Product: Subject to compliance with requirements, provide products by one of the following
      a. 3M Scotch 471.
      b. Permacel.
      c. Texcel.

2.5 DUCT LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Brady Corporation.
   2. Marking Sevices Inc.
   3. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 3.2 mm (1/8 inch) thick, and having predrilled holes for attachment hardware.

C. Letter Color: White.

D. Background Color: Black.

E. Maximum Temperature: Able to withstand temperatures up to 71 deg C (160 deg F).

F. Minimum Label Size: Length and width vary for required label content, but not less than 64 by 19 mm (2-1/2 by 3/4 inch.

G. Minimum Letter Size: 6.4 mm (1/4 inch) for name of units if viewing distance is less than 600 mm (24 inches, 13 mm (1/2 inch) for viewing distances up to 1830 mm (72 inches), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include 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.

2.6 STENCILS

A. Stencils for Ducts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brimar Industries, Inc.
b. Carlton Industries, LP.
c. Champion America.
d. Craftmark Pipe Markers.
e. Kolbi Pipe Marker Co.
f. Marking Sevices Inc.

2. Lettering Size: Minimum letter height of 32 mm (1-1/4 inches) for viewing distances up to 4-1/2 m (15 feet) and proportionately larger lettering for greater viewing distances.

3. Stencil Material: Fiberboard or metal.
4. Stencil Paint: Exterior, gloss, enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, enamel. Paint may be in pressurized spray-can form.

2.7 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Marking Sevices Inc.
3. Seton Identification Products.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 75 by 133 mm (3 by 5-1/4 inches) minimum.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

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

B. Locate equipment labels where accessible and visible.

C. Include nameplates for the following general categories of equipment:

1. Fans, blowers, and primary balancing dampers.
2. Computer Room Air Conditioners and Air-Cooled Condensing Units.
3. Concealed equipment: CRAC units, control dampers, controllers, etc. concealed above ceilings or behind walls.
    a. Label ceiling T-grid or hard-ceiling or wall access panel.

D. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment.

1. Letter Size: Minimum 6.4 mm (1/4 inch) for name of units if viewing distance is less than 600 mm (24 inches), 13 mm (1/2 inch) for viewing distances up to 1830 mm (72 inches), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
   a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
   b. Meters, gages, thermometers, and similar units.
   c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
   d. Heat exchangers, coils, evaporators, dry coolers, heat recovery units, and similar equipment.
   e. Fans, blowers, and primary balancing dampers.
   f. Packaged and Custom HVAC central-station and zone-type units.
   g. Tanks and pressure vessels.
   h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
   i. ATC panels, controllers, valves, dampers, sensors, etc.
   j. Air handling units to identify associated exhaust fan systems, if applicable.
   k. Fan coil units, cabinet unit heaters, air terminal units, duct mounted reheat coils, and similar terminal equipment.
   l. Fire, smoke, and combination fire/smoke dampers.

E. Labels in Finished Spaces: Coordinate sizes and colors with COTR.

1. Locate equipment label inside of control panel cover and provide a second label on outside of equipment with just the equipment designation (small, unobtrusive).
2. Install access panel markers (small, unobtrusive) with screws on equipment access panels, equipment access doors, and ceiling grid below concealed equipment.
3. Install markers with device identification and on face of ceiling directly below device concealed above ceilings (small, unobtrusive).

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Paint piping in exposed areas. Painting of piping is specified in Division 09 Section "Interior Painting."
   1. Colors for piping shall be as specified for label colors in ASME A13.1 and as approved by COTR.

B. Pipe Label Applications: Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Exterior Pipes with OD, Including Insulation, Less Than 152.4 mm (6 Inches) shall be one of the following:
   a. Pretensioned pipe markers. Use size to ensure a tight fit.
   b. Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 19.05 (3/4 inch) wide, lapped at least 38.1 (1-1/2 inches) at both ends of pipe marker, and covering full circumference of pipe.
2. Exterior Pipes with OD, Including Insulation, 152.4 mm (6 Inches) and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 38.1 (1-1/2 inches) wide, lapped at least 76.2 mm (3 inches) at both ends of pipe marker, and covering full circumference of pipe.

C. Pipe Label Locations: 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 90-degree elbow.
3. Near each branch connection, excluding short takeoffs for fixtures, equipment, and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
    a. No identification required for DN 40 (NPS 1-1/2) and smaller exposed at connections to equipment or plumbing fixtures.
4. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
5. At access doors, manholes, and similar access points that permit view of concealed piping.
6. Near major equipment items and other points of origination and termination.
7. Spaced at maximum intervals of 7.6 m (25 feet) along each run.
    a. In exposed finished spaces, use maximum intervals of 6 m (20 feet) along each run.
8. Exposed Piping in Finished Spaces: Identification stripes of tape in lieu of labels with letters. Space between tape stripes equal to the width of the tape.

D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

E. Pipe Label Color Schedule:

1. Condensate Drain Piping: White letters on a safety-green background.
2. Refrigerant Piping:White letters on a safety-purple background.

F. Pipe Stripe Color Schedule: Coordinate quantity and color of tape stripes with COTR, but assume on average 2 tape stripes per pipe.

3.5 DUCT LABEL AND ACCESS PANEL & DOOR MARKER INSTALLATION

A. Install plastic-laminated or 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.

B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels when duct is not visible in finished spaces, at Installer's option.

C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 15 m (50 feet) in each space where ducts are exposed or concealed by removable ceiling system.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.8 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 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 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 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.
    c. Primary-secondary hydronic systems.
3. Balancing steam systems.
4. Testing, Adjusting, and Balancing Equipment:
    a. Heat exchangers.
    b. Motors.
    c. Chillers.
    d. Cooling towers.
    e. Condensing units.
    f. Boilers.
    g. Heat-transfer coils.
5. Sound tests.
6. Vibration tests.
7. Duct leakage tests.
8. Control system verification.
9. Domestic hot water recirculation system.

B. Related Sections include the following:

1. Division 01 Sustainability Sections for additional requirements related to the LEED certification process.
2. Division 01 “General Commissioning Requirements” and Division 23 “Commissioning of HVAC” for coordination with Commissioning Agent.
3. Division 22 Sections “Fuel-Fired, Domestic-Water Heaters” and “Plumbing Specialties” for hot water recirculation pumps and balancing valves.

1.4 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.5 PREINSTALLATION MEETINGS

A. TAB Conference: If requested by the Owner, conduct TAB conference(s) at Project site after approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Schedule meetings with the Commissioning Authority.
2. Meeting Quantity: Total of 7 (1 per construction zone).
3. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.6 ACTION SUBMITTALS

A. LEED Submittals:

1. Air-Balance Report for Prerequisite IEQ 1: Documentation indicating that work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
2. TAB Report for Prerequisite EA 2: Documentation indicating that work complies with ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Outside air sampling test results.

C. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

D. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

E. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

F. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

G. Certified TAB reports: Indicating certification.

H. Sample report forms: For each type of form.

I. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.8 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB specialist and certified by AABC or NEBB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

E. Compliance with ANSI S12.2-1995 Criteria for Evaluating Room Noise.

F. Compliance with ANSI S12.34-1988 Engineering Method for the Determination of Sound Power Levels of Noise Sources for Essentially Free-Field Conditions over a Reflecting Plane.

G. ANSI S12.12 Engineering method for the determination of sound power levels of noise sources using sound intensity

1.9 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Testing and Balancing Plan: The Contractor shall review the Division 01 General Requirements and the General Contractor's Project Schedule. Contractor shall provide the COTR with a TAB Plan that includes a schedule indicating when each area is to be completed and the measures taken to isolate this work from the occupied spaces. Any disruptions to the occupied spaces shall be highlighted within the plan. TAB work shall not commence until TAB Plan is found acceptable to the COTR.

1. Expedite TAB report submittals, which must be approved by the Architect prior to commencing Functional Performance Testing in support of the Commissioning Process.

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 installed systems for 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 applicable for intended purpose and 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 and underfloor air plenums used for supply, return, or relief air to verify that they 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 verify that bearings are greased, belts are aligned and tight, filters are clean, 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 have been replaced by permanent screens with indicated perforations.

L. Examine control valves for proper installation for their intended function of throttling, 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 the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.3 OUTSIDE AIR SAMPLING AND TESTING

A. Perform outside air sampling at third floor terraces below the 8 outside air intake louver locations.

B. Measure temperature, humidity, carbon dioxide, carbon monoxide, nitrous oxide, and VOC levels.

C. Take measurements twice on different days.

3.4 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"or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

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, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in metric (SI) and inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

M. Validate airflow measuring systems at scheduled maximum and minimum airflow rates. Follow manufacturer’s written procedures for validation of each type of installation.

N. For fans with variable frequency controllers or electronically commutated motors, but without associated airflow measuring stations, record fan airflow from 25-percent to 100-percent speed in 10-percent increments.

O. Establish required supply to return (outside air to exhaust) air flow offset for each system to maintain building pressurization at 0.05" w.g.

3.6 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. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report artificial loading of filters at the time static pressures are measured.

3. 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.
4. Obtain approval from COTR for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. 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 occurs. 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.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.

3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point 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.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
    g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
    c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
    b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:

    a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
    b. Re-measure and confirm that total airflow is within design.
    c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
    d. Mark final settings.
    e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
    f. Verify tracking between supply and return fans.

3.8 PROCEDURES FOR SMOKE PURGE SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Modulate outside-air, return-air, and relief-air dampers of the associated air handling unit for proper position that simulates smoke conditions in a single gallery.
b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows: directly at the fan inlet.
3. If air flow from the given gallery is below 10,000 CFM (target), adjust fan speed to meet target. 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 occurs.

B. Repeat process for each individual gallery to verify air flow target can be achieved. Record required fan speed for each gallery.

C. Submit readings to Architect for review.

3.9 PROCEDURES FOR PAINT SPRAY BOOTH SYSTEMS

A. Adjust supply and exhaust airflows as indicated for General Procedures and Procedures for Constant-Volume Air Systems.

B. Establish normal differential static pressure between paint spray room and adjacent space to determine alarm condition on the BAS.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

D. For pumps with variable frequency controllers or electronically commutated motors, but without associated electronic flow meters, record pump flow from 25-percent to 100-percent speed in 10-percent increments.

E. For equipment with differential pressure transmitters, but without dedicated electronic flow meters, isolate other equipment and record equipment differential pressure and associated pump flow from 25-percent to 100-percent speed in 10-percent increments.

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.
d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.

5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.12 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.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.

4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

a. Measure differential pressure and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential-pressure set point.
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
c. Mark final settings.

10. Verify that memory stops have been set.

D. For systems with diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Adjust pumps to deliver total design gpm.

    a. Measure total water flow.

        1) Position valves for full flow through coils.
        2) Measure flow by main flow meter, if installed.
        3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

    b. Measure pump TDH as follows:

        1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
        2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
        3) Convert pressure to head and correct for differences in gage heights.
        4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
        5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

    c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

    a. Measure flow in main and branch pipes.
    b. Adjust main and branch balance valves for design flow.
    c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

    a. Measure flow at terminals.
    b. Adjust each terminal to design flow.
    c. Re-measure each terminal after it is adjusted.
    d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
    e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

    a. Measure differential pressure, and verify that it is within manufacturer's specified range.
    b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

    a. Measure and balance coils by either coil pressure drop or temperature method.
    b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system differential-pressure set point.
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:

    a. Re-measure and confirm that total water flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
    c. Mark final settings.

13. Verify that memory stops have been set.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first.

B. Balance the secondary circuits after the primary circuits are complete.

C. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

    a. Position valves for full flow through coils.
    b. Measure flow by main flow meter, if installed.
    c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

    a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    c. Convert pressure to head and correct for differences in gage heights.
    d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

D. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

E. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

F. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

G. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

H. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

I. Verify that memory stops have been set.

3.14 PROCEDURES FOR STEAM SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.

B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.

C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

D. Check settings and operation of each safety valve. Record settings.

E. Verify the operation of each steam trap.

3.15 PROCEDURES FOR HEAT EXCHANGERS

A. Adjust water flow to within specified tolerances.

B. Measure inlet and outlet water temperatures.

C. Measure inlet steam pressure.

D. Check settings and operation of safety and relief valves. Record settings.

3.16 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. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers:

1. Test manual bypass of controller to prove proper operation.
2. Confirm proper installation of shaft grounding rings

3.17 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.18 PROCEDURES FOR COOLING TOWERS

A. Balance total condenser-water flows to towers. Measure and record the following data:

1. Condenser-water flow to each cell of the cooling tower.
2. Entering- and leaving-water temperatures.
3. Wet- and dry-bulb temperatures of entering air.
4. Wet- and dry-bulb temperatures of leaving air.
5. Condenser-water flow rate recirculating through the cooling tower.
6. Cooling-tower spray pump discharge pressure.
7. Condenser-water flow through bypass.
8. Fan and motor operating data.

3.19 PROCEDURES FOR BOILERS

A. Hydronic Boilers:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Record relief valve pressure setting.

3.20 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 for major (more than 1.3 l/s (20 gpm)) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.

2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.21 SOUND TESTS

A. After the systems are balanced and construction is Substantially Complete, measure and record sound levels at 15 locations as designated by the COTR.

B. Instrumentation:

1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
3. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:

1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
2. Equipment should be operating at design values.
3. Calibrate the sound-testing meter prior to taking measurements.
4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight un-weighted octave bands 63 Hz to 8000 Hz (NC) with the equipment operating.
7. Take readings no closer than 900 mm (36 inches) from a wall or from the operating equipment and approximately 1500 mm (60 inches) from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:

a. Location.
b. System tested.
c. dBA reading.
d. Sound pressure level in each octave band with equipment on and off.

2. Plot sound pressure levels on NC worksheet with equipment on and off.

3.22 VIBRATION TESTS

A. After systems are balanced and construction is Substantially Complete, measure and record vibration levels on equipment having motor horsepower equal to or greater than 10.

B. Instrumentation:

1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:

1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
4. Record CPM or rpm.
5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:

1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from the AABC National Standards. Acceptable levels of vibration are normally "smooth" to "good."
4. Include in report General Machinery Vibration Severity Chart, with conditions plotted.

3.23 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.24 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended. TAB contractor shall actively participate in the calibration of controllers measuring air and water flow volume. Air flow measurement devices shall be calibrated at minimum and maximum flow rates (per phase where applicable) and documented in the TAB report.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.25 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

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

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

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

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow 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.

3.26 TOLERANCES

A. Set HVAC system's airflow 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 10 percent.
4. Cooling-Water Flow Rate: Plus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.27 PROGRESS 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.

3.28 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.
3. Certify validity and accuracy of field data.

B. Phasing: Provide final report for each construction zone.

1. Include update on changes to existing systems for each construction zone.

C. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
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. Fan drive settings including settings and percentage of maximum pitch diameter.
    e. Inlet vane settings for variable-air-volume systems.
    f. Settings for supply-air, static-pressure controller.
    g. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.

3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in mm (inches), and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in mm (inches).
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in mm (inches), and bore.
    f. Center-to-center dimensions of sheave and amount of adjustments in mm (inches).

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in L/s (cfm).
    b. Total system static pressure in Pa (inches wg).
    c. Fan rpm.
    d. Discharge static pressure in Pa (inches wg).
    e. Filter static-pressure differential in Pa (inches wg).
    f. Preheat-coil static-pressure differential in Pa (inches wg).
    g. Cooling-coil static-pressure differential in Pa (inches wg).
    h. Heating-coil static-pressure differential in Pa (inches wg).
    i. Outdoor airflow in L/s (cfm).
    j. Return airflow in L/s (cfm).
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in mm (fins per inch) o.c.
f. Make and model number.
g. Face area in sq. m (sq. ft.).
h. Tube size in DN (NPS).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in L/s (cfm).
b. Average face velocity in m/s (fpm).
c. Air pressure drop in Pa (inches wg).
d. Outdoor-air, wet- and dry-bulb temperatures in deg C (deg F).
e. Return-air, wet- and dry-bulb temperatures in deg C (deg F).
f. Entering-air, wet- and dry-bulb temperatures in deg C (deg F).
g. Leaving-air, wet- and dry-bulb temperatures in deg C (deg F).
h. Water flow rate in L/s (gpm).
i. Water pressure differential in kPa (feet of head or psig).
j. Entering-water temperature in deg C (deg F).
k. Leaving-water temperature in deg C (deg F).

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in kW (Btu/h).
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in L/s (cfm).
i. Face area in sq. m (sq. ft.).
j. Minimum face velocity in m/s (fpm).

2. Test Data (Indicated and Actual Values):

a. Heat output in kW (Btu/h).
b. Airflow rate in L/s (cfm).
c. Air velocity in m/s (fpm).
d. Entering-air temperature in deg C (deg F).

e. Leaving-air temperature in deg C (deg F).
f. Voltage at each connection.
g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in mm (inches), and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in mm (inches).

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in mm (inches), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in mm (inches).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in L/s (cfm).
b. Total system static pressure in Pa (inches wg).
c. Fan rpm.
d. Discharge static pressure in Pa (inches wg).
e. Suction static pressure in Pa (inches wg).

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg C (deg F).
d. Duct static pressure in Pa (inches wg).
e. Duct size in mm (inches).
f. Duct area in sq. m (sq. ft.).
g. Indicated airflow rate in L/s (cfm).
h. Indicated velocity in m/s (fpm).
i. Actual airflow rate in L/s (cfm).
j. Actual average velocity in m/s (fpm).
k. Barometric pressure in Pa (psig).

K. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. m (sq. ft.).

2. Test Data (Indicated and Actual Values):

a. Airflow rate in L/s (cfm).
b. Air velocity in m/s (fpm).
c. Preliminary airflow rate as needed in L/s (cfm).
d. Preliminary velocity as needed in m/s (fpm).
e. Final airflow rate in L/s (cfm).
f. Final velocity in m/s (fpm).
g. Space temperature in deg C (deg F).

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in L/s (cfm).
b. Entering-water temperature in deg C (deg F).
c. Leaving-water temperature in deg C (deg F).
d. Water pressure drop in kPa (feet of head or psig).
e. Entering-air temperature in deg C (deg F).
f. Leaving-air temperature in deg C (deg F).

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.

d. Make and size.
e. Model number and serial number.
f. Water flow rate in L/s (gpm).
g. Water pressure differential in kPa (feet of head or psig).
h. Required net positive suction head in kPa (feet of head or psig).
i. Pump rpm.
j. Impeller diameter in mm (inches).
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in kPa (feet of head or psig).
b. Pump shutoff pressure in kPa (feet of head or psig).
c. Actual impeller size in mm (inches).
d. Full-open flow rate in L/s (gpm).
e. Full-open pressure in kPa (feet of head or psig).
f. Final discharge pressure in kPa (feet of head or psig).
g. Final suction pressure in kPa (feet of head or psig).
h. Final total pressure in kPa (feet of head or psig).
i. Final water flow rate in L/s (gpm).
j. Voltage at each connection.
k. Amperage for each phase.

N. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.29 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of COTR.

B. COTR shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, COTR may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.30 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. Verification of Previously Completed Zones: Perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

C. 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.

D. Whole Building Commissioning: At the completion of Phase 2 and following the acceptance of final TAB reports for those zones within Phase 2, perform additional measurements for previously accepted systems as part of Whole Building Commissioning. Readings will be limited to total flow measurement of selected air (supply, return, exhaust) to verify whole building pressurization and system interactions including normal, economizer, and smoke purge modes of operation.

1. Airside systems: Following completion of Phase 2 activities, conduct the following tests for the entire building, including previously completed phases and zones:

a. Normal Mode:

1) All systems will be set to normal operation – occupied mode, minimum outside air, all controls operating automatically
2) Verify building pressurization, relative to outdoors, at each zone. Building shall maintain slight positive pressurization unless directed otherwise by COTR.
3) Verify airflow rates at each supply, return or exhaust fan by direct measurement, except those zones where TAB verification has occurred within a 12-month period prior to Whole Building Commissioning. Perform additional calibration of air flow monitoring stations where variance from measured airflow is greater than 5-percent.

b. Economizer Mode:

1) For each system capable of direct or indirect economizer operation, set the systems to operate in economizer mode with all controls operating automatically. For systems capable of partial economizer, set the systems to maintain minimum recirculation/maximum exhaust.
2) Verify building pressurization, relative to outdoors, at each zone. Building shall maintain slight positive pressurization unless directed otherwise by the COTR.
3) Verify airflow rates at each supply, return or exhaust fan by direct measurement, except those zones where TAB verification has occurred within a 12-month period prior to Whole Building Commissioning. Perform additional calibration of air flow monitoring stations where variance from measured airflow is greater than 5-percent.

c. Smoke Purge Mode

1) Enter the smoke purge mode by direct command. All non-affected systems shall be indexed to the "off" position.
2) Verify operation of all associated fans to the performance levels set at previous smoke purge settings. Verify airflow by direct measurement for all smoke purge exhaust fans to ensure the efficacy of the system, except those zones where TAB verification has occurred within a 12-month period prior to Whole Building Commissioning, and provided that on-going construction activities have not affected system design or connections.
3) Measure and record building pressurization, relative to outdoors, in each zone during smoke purge mode.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. This section also applies to Division 22 Plumbing Specification Sections.

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section includes insulating ductwork, piping, and equipment.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

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

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.
5. Detail field application for each equipment type.
6. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Conform with ASTM C1071-91 Thermal and Acoustical Insulation (Mineral Fiber, Duct Lining Material).

C. ASTM E1222-90 Test Method for Laboratory Measurement of Insertion Loss of Pipe Lagging Systems.

D. 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

D. Coordinate clearance requirements with equipment installer for equipment installation application.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Insulation Application Schedule" article 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. Insulation shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50, when tested in accordance with ASTM E84.

G. Interior wet-applied adhesives, sealants, mastics: Comply with low-emitting requirements in Division 01 Section “Sustainable Design Requirements.”

H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Aeroflex USA, Inc.; Aeroseal.
    b. Armacell LLC.; AP Armaflex.
    c. K-Flex USA.; Insul-Sheet and Insul-Tube 180.

2. Maximum K-Factor: 0.041 at 24 deg C (0.28 at 75 deg. F) mean temperature.
3. Water Vapor Permeability: 0.51 perm-mm (0.02 perm-inch) per ATM E96 Procedure A.
4. Insulation shall be approved according to FM Approval Standard 4924 (Approval Standard for Pipe and Duct Insulation, current edition).

I. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Corporation.; Duct Wrap.
    b. Johns Manville; a Berkshire Hathaway company; Microlite.
    c. Knauf Insulation; Duct Wrap.
    d. Owens Corning; All-Service Duct Wrap.

2. Maximum K-Factor: 0.042 at 24 deg C (0.29 at 75 deg. F) and material thickness compressed 25-percent.
3. Minimum Density: 12 kg per cubic meter (0.75 pounds per cubic foot).

J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied ASJ for equipment and FSK for ductwork. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Corporation; Commercial Board.
    b. Johns Manville; a Berkshire Hathaway company; 800 Series Spin-Glas, Type 814.
    c. Knauf Insulation; Insulation Board.
    d. Owens Corning; Fiberglas 700 Series.

2. Maximum K-Factor: 0.033 at 24 deg C (0.23 at 75 deg. F) mean temperature.
3. Minimum Density: 48 kg per cubic meter (3.0 pounds per cubic foot).

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company; Micro-Lok.
    b. Knauf Insulation; 1000 (Pipe Insulation).
    c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 454 Deg C (850 Deg F) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, 649 Deg C (1200 Deg F) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
4. Maximum K-Factor: 0.033 at 24 deg C (0.23 at 75 deg. F) mean temperature; 0.34 at 121 deg C (250 deg. F) mean temperature.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Insulco, Division of MFS, Inc.; Triple I.
    b. P. K. Insulation Mfg. Co., Inc.; Super-Stik
    c. Ramco Insulation, Inc.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
    b. Ramco Insulation, Inc.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Insulco, Division of MFS, Inc.; SmoothKote.
    b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    c. Ramco Insulation, Inc.
    d. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Aeroflex USA, Inc.
    b. Armacell LLC.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. K-Flex USA.

2. Emissions for wet-applied adhesives: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and a VOC content of 250 g/L or less.

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Mon-Eco Industries, Inc.

2. Emissions for wet-applied adhesives: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and a VOC content of 250 g/L or less.
3.

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Mon-Eco Industries, Inc.

2. Emissions for wet-applied adhesives: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and a VOC content of 250 g/L or less.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation.
b. Johns Manville; a Berkshire Hathaway company.
c. P.I.C. Plastics, Inc.
d. Speedline Corporation.

2. Emissions for wet-applied adhesives: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and a VOC content of 250 g/L or less.

2.4 MASTICS

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

1. Emissions for wet-applied mastics: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and a VOC content of 100 g/L or less.

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Foster Brand; H. B. Fuller Construction Products.
b. Knauf Insulation.
c. Vimasco Corporation.

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

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Mon-Eco Industries, Inc.

2. Water-Vapor Permeance: ASTM F 1249, 0.03 metric perm (0.05 perm) at 0.9-mm (35-mil) dry film thickness.

3. Service Temperature Range: Minus 18 to plus 82 deg C (0 to 180 deg F).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.

2. Water-Vapor Permeance: ASTM F 1249, 0.03 metric perm (0.05 perm) at 0.8-mm (30-mil) dry film thickness.
3. Service Temperature Range: Minus 46 to plus 104 deg C (Minus 50 to plus 220 deg F).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Knauf Insulation.
   e. Mon-Eco Industries, Inc.
   f. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM F 1249, 1.2 metric perms (1.8 perms) at 1.6-mm (0.0625-inch) dry film thickness.
3. Service Temperature Range: Minus 29 to plus 82 deg C (Minus 20 to plus 180 deg F).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. FSK Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

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 121 deg C (Minus 40 to plus 250 deg F).
5. Color: Aluminum.
6. Emissions for wet-applied sealants: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and a VOC content of 420 g/L or less.

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

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Childers Brand; H. B. Fuller Construction Products.

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 121 deg C (Minus 40 to plus 250 deg F).
5. Color: White.
6. Emissions for wet-applied sealants: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and a VOC content of 420 g/L or less.

2.6 JOINT SEALANTS

A. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.
   e. Pittsburgh Corning Corporation.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 73 to plus 149 deg C (Minus 100 to plus 300 deg F).
5. Color: White or gray.
6. Emissions for wet-applied sealants: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and a VOC content of 420 g/L or less.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: 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. Vinyl Jacket: White vinyl with a permeance of 0.86 metric perm (1.3 perms) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 203 g/sq. m (6 oz./sq. yd.) with a thread count of 2 strands by 2 strands/sq. mm (5 strands by 5 strands/sq. in.) for covering ducts.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Childers Brand; H. B. Fuller Construction Products.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 271 g/sq. m (8 oz./sq. yd.).

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Alpha Associates, Inc.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mil thickness; roll stock ready for shop or field cutting and forming.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; Lo Smoke.
d. Speedline Corporation; SmokeSafe.

2. Emissions for wet-applied adhesives: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and a VOC content of 250 g/L or less
3. Color: Color-code jackets based on system. Color as selected by COTR from standard available color options. Color scheme will be generally as follow for exposed piping in Mechanical Rooms:
a. Primary Chilled Water: Blue
b. Secondary Chilled Water: Light Blue
c. Heating Hot Water: Yellow
d. Condenser Water: Gray
e. Domestic Cold Water, Domestic Hot Water and Hot Water Recirculating: Green
f. Industrial Cold Water, Industrial Hot Water and Hot Water Recirculating: Green
g. Compressed Air: Light Gray

h. Drain: Light Green
i. Hazardous Waste: Purple
j. Gas: Yellow
k. PVC jackets on services not indicated above: white

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

C. Self-Adhesive Outdoor Jacket: 60-mil- thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.
1. Products:
a. MFM Building Products Corp., Flex Clad 400.
b. Polyguard; Alumaguard 60.
c. Venture Tape, VentureClad 1577.

2.11 TAPES

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Compac Corporation.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.
e. Venture Tape.

2. Width: 75 mm (3 inches).
3. Thickness: 0.29 mm (11.5 mils).
4. Adhesion: 1.0 N/mm (90 ounces force/inch) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 7.2 N/mm (40 lbf/inch) 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Compac Corporation.

c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.
e. Venture Tape.

2. Width: 75 mm (3 inches).
3. Thickness: 0.16 mm (6.5 mils).
4. Adhesion: 1.0 N/mm (90 ounces force/inch) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 7.2 N/mm (40 lbf/inch) 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Compac Corporation.
b. Ideal Tape Co., Inc., an American Biltrite Company.
c. Venture Tape.

2. Width: 50 mm (2 inches).
3. Thickness: 0.15 mm (6 mils).
4. Adhesion: 0.7 N/mm (64 ounces force/inch) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 3.3 N/mm (18 lbf/inch) in width.

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Compac Corporation.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.
e. Venture Tape.

2. Width: 50 mm (2 inches).
3. Thickness: 0.093 mm (3.7 mils).
4. Adhesion: 1.1 N/mm (100 ounces force/inch) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 6.2 N/mm (34 lbf/inch) in width.

2.12 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.38 mm (0.015 inch) thick, 19 mm (3/4 inch) wide with wing seal or closed seal.
3. Aluminum: ASTM B 209M (ASTM B 209), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.51 mm (0.020 inch) thick, 19 mm (3/4 inch) wide with wing seal or closed seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 3.5-mm- (0.135-inch-) diameter shank, length to suit depth of insulation indicated.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.
4) Midwest Fasteners, Inc.
5) Nelson Stud Welding.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 3.5-mm- (0.135-inch-) diameter shank, length to suit depth of insulation indicated with integral 38-mm (1-1/2-inch) galvanized carbon-steel washer.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) CL WARD & Family Inc.
3) Gemco.
4) Hardcast, Inc.
5) Midwest Fasteners, Inc.
6) Nelson Stud Welding.

3. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Midwest Fasteners, Inc.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.76 mm (0.030 inch) thick by 50 mm (2 inches) square.
c. Spindle: Stainless steel, fully annealed, 2.6-mm- (0.106-inch-) 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.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.41-mm- (0.016-inch-) thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 38 mm (1-1/2 inches) in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.
4) Midwest Fasteners, Inc.
5) Nelson Stud Welding.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 19-mm- (3/4-inch-) wide, stainless steel or Monel.

D. Wire: 1.6-mm (0.062-inch) soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. C & F Wire.

2.13 CORNER ANGLES

A. Aluminum Corner Angles: 1.0 mm (0.040 inch) thick, minimum 25 by 25 mm (1 by 1 inch), aluminum according to ASTM B 209M (ASTM B 209), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.61 mm (0.024 inch) thick, minimum 25 by 25 mm (1 by 1 inch), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 0.127 mm (5 mils) thick and an epoxy finish 0.127 mm (5 mils) thick if operating in a temperature range between 60 and 149 deg C (140 and 300 deg F). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 0 and 149 deg C (32 and 300 deg F) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. 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. Install insulation continuously through hangers and around anchor attachments.

K. 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 insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 75-mm- (3-inch-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 100 mm (4 inches) o.c.
3. Overlap jacket longitudinal seams at least 38 mm (1-1/2 inches). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 50 mm (2 inches) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 100 mm (4 inches) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. 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.
7. Unions.
8. Heating water strainers (1-inch and less).
9. Flanges
10. Expansion joints.
11. Heating water valves (1-inch and less).

3.4 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 50 mm (2 inches) 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 50 mm (2 inches).
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: Install insulation continuously through penetrations of fire-rated walls and partitions. 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 50 mm (2 inches).

1. Comply with requirements in Division 07 Section "Firestopping."

E. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. 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 50 mm (2 inches).
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
    a. Where fiberglass insulation is indicated for a service, the following may be provided:
        1) For service temperatures 200 degrees F and below: PVC fitting covers with fiberglass inserts.
        2) For service temperatures above 200 degrees F: Aluminum fitting covers with fiberglass inserts.
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.
    a. Where fiberglass insulation is indicated for a service, the following may be provided:
        1) For service temperatures 200 degrees F and below: PVC fitting covers with fiberglass inserts.
        2) For service temperatures above 200 degrees F: Aluminum fitting covers with fiberglass inserts.
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.
    a. Provide packaged removable formed covers for valves 50 mm (2 inches) and larger.
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 50 mm (2 inches) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Flexible elastomeric insulation shall not be used on pipes with a diameter greater than 457 mm (18 inches).

B. Where flexible elastomeric insulation is installed in collection storage spaces, comply with one of the following:

1. FM Approval 4910 (American National Standard for Cleanroom Materials Flammability).
2. Pass the optional smoke-sensitive occupancy rating for pipe insulation, as defined in the FM 4924 standard.

C. 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.

D. 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.

E. 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.

F. 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 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 150 mm (6 inches) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

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

C. Insulation Installation on Pipe Fittings and Elbows:

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

D. Insulation Installation on Valves and Pipe Specialties:

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

E. Blanket Insulation Installation on Ducts and Plenums: Secure with insulation pins.

1. 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 450 mm (18 inches) and smaller, place pins along longitudinal centerline of duct. Space 75 mm (3 inches) maximum from insulation end joints, and 400 mm (16 inches) o.c.
    b. On duct sides with dimensions larger than 450 mm (18 inches), place pins 400 mm (16 inches) o.c. each way, and 75 mm (3 inches) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

2. 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 50 mm (2 inches) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 13-mm (1/2-inch) outward-

clinching staples, 25 mm (1 inch) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 10 deg C (50 deg F) at 5.5-m (18-foot) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 75 mm (3 inches).

3. Overlap unfaced blankets a minimum of 50 mm (2 inches) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 450 mm (18 inches) o.c.
4. 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.
5. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 150-mm- (6-inch-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 150 mm (6 inches) o.c.

F. 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 450 mm (18 inches) and smaller, place pins along longitudinal centerline of duct. Space 75 mm (3 inches) maximum from insulation end joints, and 400 mm (16 inches) o.c.
b. On duct sides with dimensions larger than 450 mm (18 inches), space pins 400 mm (16 inches) o.c. each way, and 75 mm (3 inches) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. 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 50 mm (2 inches) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 13-mm (1/2-inch) outward-clinching staples, 25 mm (1 inch) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 10 deg C (50 deg F) at 5.5-m (18-foot) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 75 mm (3 inches).

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 150-mm- (6-inch-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 150 mm (6 inches) o.c.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 50-mm (2-inch) overlap at seams and joints.
2. Embed glass cloth between two 1.6-mm- (0.062-inch-) thick coats of lagging adhesive.

B. Completely encapsulate insulation with coating, leaving no exposed insulation.

C. Where PVC jackets are indicated, install with 25-mm (1-inch) 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.

D. Where metal jackets are indicated, install with 50-mm (2-inch) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 300 mm (12 inches) o.c. and at end joints.

3.9

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 Section "Painting and Coating."

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 COTR. 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. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Inspect field insulated ductwork, piping and equipment, randomly selected by COTR, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Insulation Application Schedule" Article.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 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. Where ductwork is required to be insulated and double-wall ductwork is provided, external insulation and jacket can be omitted.
1. If 50 mm (2-inch) thick external insulation is specified, but only 25 mm (1-inch) thick double wall ductwork is indicated, increase double wall ductwork insulation thickness to 50 mm (2-inch) and eliminate external insulation and field applied jacket.

C. Where ductwork is required to be insulated, double-wall ductwork with internal insulation thickness equal to the thickness specified for external insulation may be provided in lieu of external insulation and field applied jacket at Contractor’s Option.

D. If 50 mm (2-inch) thick insulation is required, but only 25 mm (1-inch) thick double wall ductwork is indicated, increase double wall ductwork insulation thickness to 50 mm (2-inch) and eliminate external insulation and jacketing

E. Items Not Insulated:

1. Fibrous-glass ducts.
2. Factory-insulated flexible ducts.
3. Factory-insulated ducts, plenums, and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.
7. Underground piping.
8. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

F. Provide removable, replaceable insulation plugs at manufacturer's equipment identification plates and at ASME pressure vessel plates on insulated equipment.

3.12 INSULATION APPLICATION SCHEDULES

SERVICE	INSULATION MATERIAL	INSULATION THICKNESS MM (INCH)	VAPOR RETARDER REQUIRED
INDOOR DOMESTIC HOT AND RECIRCULATED HOT WATER PIPING			
32 (1¼") diameter and smaller (Note 4)	Mineral Fiber; or Flexible Elastomeric	25 (1)	No
38 (1½") diameter and larger	Mineral Fiber; or Flexible Elastomeric	38 (1-1/2)	No
DOMESTIC COLD WATER PIPING			
General Indoor Duty, 32 (1¼") diameter and smaller	Mineral Fiber; or; Flexible Elastomeric	13 (1/2)	Yes
General Indoor Duty, 38 (1½") diameter and larger	Mineral Fiber; or Flexible Elastomeric	13 (1/2)	Yes
Unconditioned Indoor Space (Note 1), 32 (1¼") diameter and smaller	Mineral Fiber; or; Flexible Elastomeric	25 (1)	Yes
Unconditioned Indoor Space (Note 1), 38 (1½") diameter and larger	Mineral Fiber; or Flexible Elastomeric	38 (1-1/2)	Yes
Outdoor Above Ground, All Sizes	Flexible Elastomeric	50 (2)	Yes
AIR CONDITIONING CONDENSATE DRAIN, EQUIPMENT DRAIN, & HUMIDIFIER DRAIN PIPING			
All sizes	Flexible Elastomeric	13 (1/2)	Yes
EXPOSED SANITARY DRAINS AND DOMESTIC WATER SUPPLIES AND STOPS FOR FIXTURES FOR THE DISABLED			
Refer to Division 22 Sections "Commercial Lavatories" and "Commercial Sinks."			
PIPING PENETRATIONS THROUGH CONCRETE OR MASONRY	Mineral Fiber	Match Thickness of Adjacent Insulation, Otherwise Minimum 25 (1)	Match Adjacent Insulation, Otherwise No
INDOOR SUPPLY-AIR DUCTS AND PLENUMS			
Concealed, Generally	Mineral-Fiber Blanket	50 (2)	Yes
Concealed, Return Air Plenums	Mineral-Fiber Blanket	25 (1)	Yes
Exposed in Conditioned Space within 7 feet of floor	Mineral-Fiber Board	25 (1)	Yes
Exposed in Conditioned Space greater than 7 feet above floor	Mineral-Fiber Blanket; or; Mineral-Fiber Board	25 (1)	Yes
Unconditioned Spaces (Note 1) within 7 feet of floor	Mineral-Fiber Board	50 (2)	Yes

SERVICE	INSULATION MATERIAL	INSULATION THICKNESS MM (INCH)	VAPOR RETARDER REQUIRED
Unconditioned Spaces (Note 1) greater than 7 feet above floor	Mineral-Fiber Board	50 (2)	Yes
Unconditioned Spaces (Note 1) greater than 7 feet above floor, Contractor Option	Mineral-Fiber Blanket	56 (2.2)	Yes
INDOOR RETURN-AIR DUCTS AND PLENUMS			
Concealed, Generally	Mineral-Fiber Blanket	50 (2)	Yes
Concealed, Return Air Plenums	None	--	--
Exposed in Conditioned Space	None	--	--
Unconditioned Spaces (Note 1) within 7 feet of floor	Mineral-Fiber Board	50 (2)	Yes
Unconditioned Spaces (Note 1) greater than 7 feet above floor	Mineral-Fiber Board	50 (2)	Yes
Unconditioned Spaces (Note 1) greater than 7 feet above floor, Contractor Option	Mineral-Fiber Blanket	56 (2.2)	Yes

Notes:

1. Unconditioned spaces include locations where summer temperature and humidity conditions are similar to outdoor conditions (such as equipment rooms, parking garages, etc.).

3.13 FIELD APPLIED JACKET APPLICATION SCHEDULE FOR EXTERNAL INSULATION

SERVICE	FIELD APPLIED JACKET TYPE
Indoor, exposed insulated piping within 7 feet of floor, for service temperatures 200 degrees F and below	PVC
Indoor, exposed insulated piping greater than 7 feet above floor, for service temperatures 200 degrees F and below	None
Indoor concealed piping	None
Indoor, All Locations, Fittings and valves in piping systems at service temperatures 200 degrees F and below	Factory Fabricated PVC Covers
Indoor concealed insulated ductwork	None
Indoor, exposed sanitary drains and domestic water supplies and stops for fixtures for the disabled	Refer to Division 22 Sections “Commercial Lavatories” and Commercial Sinks”

END OF SECTION 23 0700

SECTION 230923 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.1 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.2 SUMMARY

A. This Section includes all labor, materials, equipment, and service necessary for a complete and operating control system for all HVAC equipment including control of units not supplied with factory-wired controls and installation and wiring of loose controls shipped with equipment.

B. All new HVAC equipment to be provided with Direct Digital Controls (DDC) controlled through the new Building Automation System (BAS), except the following:

1. Computer Room Air Conditioning Units (CRAC) shall be provided with factory microprocessor controls and shall be monitored and enabled through the DDC systems.

C. Furnish all labor, materials, equipment, and service necessary for a complete and operating Building Automation System (BAS), utilizing a high-speed peer to peer network of interoperable Direct Digital Controls (DDC), Graphical User Interface (GUI) on the drawings and as described herein.

D. Complete BAS per construction zone, including I/O checkout procedures, pre-functional checklists, functional performance testing, and Owner acceptance.

E. Related Sections include the following:

1. Division 01 Sustainability Sections for additional requirements related to the LEED certification process.

F. The new BAS system shall be fully compatible with the existing campus control system. All new controls shall be fully accessible through the existing operator’s terminals. Division 25 contractor is responsible for determining compatibility prior to submitting bid.

Owner presently has an existing Siemens Building Automation System as part of past projects. The intent of this specification is to extend and interoperate with this system and to provide a peer-to-peer, networked control system for the control work that is part of this project. All components, software and operation shall be interoperable with the existing building automation

system. The installed system will interface directly with the existing system. The existing software and database will be modified to accept the new equipment being installed under this project to maintain integrity for centralized scheduling, trending, programming, and alarming. PC Desktop icons that “link” to a separate system are not acceptable. Any costs associated with connecting to the existing energy management system, including licensed software, programming, training etc., shall be part of the controls contractor’s bid. The contractor must demonstrate their ability to perform the integration to the existing systems prior to submittal acceptance. All systems as described in the sequence of operation will be shown via dynamic graphics with all pertinent system alarms for proper operation and maintenance. The use of separate PC workstations, gateways, metalinks, replacement of existing controllers and control devices and additional software graphic packages to accomplish this integration will not be accepted

1.3 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:

1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.
2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.

D. Binary: Two-state signal where a high signal level represents ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.

F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

G. COV: Changes of value.

H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.

I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.

J. DOCSIS: Data-Over Cable Service Interface Specifications.

K. EMT: Electric metal tube.

L. FMC: Flexible metal conduit.

M. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.

N. GRC: Galvanized rigid conduit.

O. HLC: Heavy load conditions.

P. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.

Q. LAN: Local area network.

R. LFMC: Liquid-tight flexible metal conduit.

S. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

T. Modbus TCP/IP: An open protocol for exchange of process data.

U. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

V. MTBF: Mean time between failures.

W. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

X. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

Y. PDA: Personal digital assistant.

Z. Peer to Peer: Networking architecture that treats all network stations as equal partners.

AA. POT: Portable operator's terminal.

BB. PUE: Performance usage effectiveness.

CC. RAM: Random access memory.

DD. RF: Radio frequency.

EE. RNC: Rigid non-metal conduit.

FF. Router: Device connecting two or more networks at network layer.

GG. Server: Computer used to maintain system configuration, historical and programming database.

HH. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

II. UPS: Uninterruptible power supply.

JJ. USB: Universal Serial Bus.

KK. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

LL. VAV: Variable air volume.

MM. WLED: White light emitting diode.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 GENERAL SUBMITTAL REQUIREMENTS

A. Multiple Submissions:

1. If multiple submissions are required to execute work within schedule, first submit a coordinated schedule clearly defining intent of multiple submissions. Include a proposed date of each submission with a detailed description of submittal content to be included in each submission.
2. Clearly identify each submittal requirement indicated and in which submission the information will be provided.
3. Include an updated schedule in each subsequent submission with changes highlighted to easily track the changes made to previous submitted schedule.

B. Per submittal process, full point names must be submitted. All point names must adhere to SI point naming conventions for both points and panels.

C. Check with SI BAS to gain access to naming convention list spreadsheet. Smithsonian Point Naming.xlsx

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
   a. Gateways.
   b. Routers.
   c. DDC controllers.
   d. Enclosures.
   e. Electrical power devices.
   f. Accessories.
   g. Instruments.
   h. Control valves and actuators.
6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Sustainable Design Submittals: Comply with Division 01 Section “Sustainable Design Requirements.”

1. EQ Prerequisite: Indoor Air Quality Performance
   a. For wall-mounted carbon dioxide sensors, documentation indicating accuracy in percent.
2. EQ Credit: Low Emitting Materials
   a. Emissions for wet-applied solvent cements, adhesives, adhesive primers: Documentation indicating compliance with California Department of Public Health (CDPH) Standard Method v1.1-2010 and VOC content in g/L.

C. Shop Drawings:

1. General Requirements:
   a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
   b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
   c. Prepare Drawings using CAD.
   d. Drawings Size: Minimum of 279 mm x 432 mm (11 inch x 17 inch).
2. Include plans, elevations, sections, and mounting details where applicable.

3. Include details of product assemblies. Indicate dimensions, method of field assembly, components, and location and size of each field connection.
4. Plan Drawings indicating the following:

    a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
    b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
    c. Exact placement of sensors in rooms, drawn to scale to reflect proposed installed condition.
    d. Network communication cable and raceway routing.
    e. Information, drawn to scale, of panel elevations in mechanical, electrical, plumbing and teledata rooms. Show clearances to adjacent systems and equipment.

5. Schematic drawings for each controlled HVAC system indicating the following:

    a. I/O points labeled with full point names. All point names must adhere to SI point naming conventions for both points and panels. Check with SI to gain access to naming convention list spreadsheet (Smithsonian Point Naming.xlxs). Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
    b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
    c. A graphic showing location of control I/O in proper relationship to HVAC system.
    d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
    e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
    f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
    g. Narrative sequence of operation.

6. Control panel drawings indicating the following:

    a. Panel dimensions, materials, and size.
    b. Interior subpanel layout, showing all internal components, and cabling.
    c. Front, rear, and side elevations.
    d. Unique drawing for each panel.

7. DDC system network riser diagram indicating the following:

    a. Each device connected to network with unique identification for each.
    b. Interconnection of each different network in DDC system.
    c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type,.
    d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.

8. DDC system electrical power riser diagram indicating the following:

a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
b. Each control power supply including, as applicable, transformers, and DC power supplies, with unique identification for each.
c. Each product requiring power with requirements (volts/phase/hertz/amperes/ connection type) listed for each.

9. Monitoring and control signal diagrams indicating the following:

a. Control signal cable and wiring between controllers and I/O.
b. Point-to-point schematic wiring diagrams for each product.

10. Color graphics indicating the following:

a. Itemized list of color graphic displays to be provided.
b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.

D. System Description:

1. Full description of DDC system architecture, network configuration, controller types and applications, gateways, routers and other network devices, and power supplies.

2. Complete bibliography of documentation and media to be delivered to Owner.
3. Description of testing plans and procedures.
4. Description of Owner training.

E. Samples:

1. For each of the following exposed product, installed in finished space for approval of selection of aesthetic characteristics:

a. Temperature sensors.
b. Humidity sensors.
c. Carbon dioxide sensors.
d. Pressure instruments specified in Division 23 Section "Pressure Instruments."

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. Systems Provider Qualification Data:

a. Resume of project manager assigned to Project.
b. Resumes of application engineering staff assigned to Project.
c. Resumes of installation and programming technicians assigned to Project.
d. Resumes of service technicians assigned to Project.
e. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.

f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
g. Names of staff assigned to past project that will also be assigned to execute work of this Project.
h. Owner contact information for past project including name, phone number, and e-mail address.
i. Contractor contact information for past project including name, phone number, and e-mail address.
j. Architect and Engineer contact information for past project including name, phone number, and e-mail address.

B. Product Certificates:

1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

C. Field quality-control reports: For field quality-control procedures to include in emergency, operation and maintenance manuals submittal.

D. Sample Warranty: For manufacturer's warranty.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
c. As-built versions of submittal Product Data.
d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to:

1) Design and install new points, panels, and other hardware.
2) Perform preventive maintenance and calibration.
3) Debug hardware problems.
4) Repair or replace hardware.

h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.

i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
j. List of recommended spare parts with part numbers and suppliers.
k. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
l. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
m. Licenses, guarantees, and warranty documents.
n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
o. Owner training materials.

B. Maintenance Materials: Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Furnish quantity indicated of matching product(s) in Project inventory for each unique size and type of following:

1. Network Controller: One.
2. Programmable Application Controller: Three.
3. Application-Specific Controller: Five.
4. Room Carbon Dioxide Sensor and Transmitter: Five.
5. Room Temperature Sensor: Five.
6. Current-Sensing Relay: Three.
7. Transformer: Three.

C. Parts List: Include product manufacturers' recommended parts lists for proper product operation over four-year period following warranty period. Parts list shall be indicated for each year.

1.9 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:

1. Nationally recognized manufacturer of DDC systems and products.
2. DDC systems with similar requirements to those indicated for a continuous period of 10 years within time of bid.
3. DDC systems and products that have been successfully tested and in use on at least five past projects.
4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
5. Having full-time in-house employees for the following:

a. Product research and development.
b. Product and application engineering.
c. Product manufacturing, testing and quality control.
d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
e. Owner operator training.

B. DDC System Provider Qualifications:

1. Authorized representative of, and trained by, DDC system manufacturer.
2. In-place facility located within 50 miles of Project.
3. Demonstrated past experience with installation of DDC system products being installed for period within five consecutive years before time of bid.
4. Demonstrated past experience on five projects of similar complexity, scope and value.
5. Each person assigned to Project shall have demonstrated past experience.
6. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
7. Service and maintenance staff assigned to support Project during warranty period.
8. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.
9. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.

    a. Install updates only after receiving Owner's written authorization.

3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
4. Warranty Period: There will be Multiple Substantial Completion dates based on Project Phasing. Refer to Division 1 Specification and General Requirements for additional information on warranty in general and relative to Phased Construction.

1.11 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate location of control panels, dampers, valves, and devices such that clearance can be maintained for proper access to all components.

C. Coordinate equipment and wiring with DIVISION 26 requirements to achieve compatibility of communication interfaces, drives, motor starters and annunciation devices.

D. Coordinate and assist Testing, Adjusting and Balancing (TAB) Contractor with proper set up and operation of HVAC Systems.

E. The minimum quantity of DDC/ATC panels are located on the contract documents. Provide additional panels as required. Panel locations must be approved by the COTR and coordinated with trades prior to installation. If approval and coordination are not completed, then panels shall be relocated at no cost to Smithsonian.

F. Do not locate DDC panels above ceilings. Panels shall be located in mechanical rooms or in equipment systems rooms.

G. Automatic temperature control valves and thermowells furnished by Control Contractor shall be installed by Division 23 Contractor under the supervision of Control Contractor.

H. Comply with requirements of Division 01 Section “General Commissioning Requirements”. Furnish Contractors for Division 01 Section “General Commissioning Requirements” and Division 23 Section “Commissioning of HVAC” approved temperature control technical data and shop drawings, information relating to changes or revisions in work, and other information required for proper balancing, adjusting and commissioning of systems.

I. Deviations from specifications shall be documented separately. Obtain approval for deviations prior to fabrication or installation. Issues shall be reviewed.

J. Mechanical equipment sent with loose controls shall be mounted and wired by Division 23.

K. Control Contractor shall provide conduit, trays, etc. required for power and control wiring to devices.

L. Control Contractor shall interlock fans or pumps through hard wiring where indicated on contract documents.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

B. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

    a. If instruments and actuators alone cannot comply with requirement, install instruments and actuators in protective enclosures that are isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by instrument and application.

2. Instruments, actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments and actuators not available with integral enclosures complying with

requirements indicated shall be housed in protective secondary enclosures. Installed location shall dictate the following NEMA 250 enclosure requirements:

a. Outdoors, Protected: Type 3.
b. Outdoors, Unprotected: Type 4X.
c. Indoors: Type 1.

d. Localized Areas Exposed to Washdown: Type 4X.
e. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2.
f. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4X.
g. Hazardous Locations: Explosion-proof rating for condition.

C. Continuity of Operation after Electric Power Interruption:

1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.2 AIR TEMPERATURE SENSORS

A. Platinum RTDs: Common Requirements:

1. 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
3. Performance Characteristics:

a. Range: Minus 40 to 116 deg C (Minus 40 to 240 deg F).
b. Interchangeable Accuracy: At zero deg C (32 deg F) within 0.3 deg C (0.5 deg F).
c. Repeatability: Within 0.3 deg C (0.5 deg F).
d. Self-Heating: Negligible.

4. Transmitter Requirements:
a. Transmitter optional for 1000-ohm RTD, contingent on compliance with end-to-end control accuracy.

B. Platinum RTD Space Air Temperature Sensors:

1. 1000 ohms.
2. Temperature Range: Minus 40 to 100 deg C (Minus 40 to 212 deg F).
3. Sensor assembly shall include a temperature sensing element mounted under a flush, brushed-aluminum cover.
4. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
5. Concealed wiring connection.
6. For temperature sensors mounted on curtain wall, provide button sensors with brushed stainless steel finish designed to accept field paint.

2.3 ENCLOSURES

A. Wall-Mounted, NEMA 250, Type 1:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Hoffman; a brand of Pentair Equipment Protection.
b. Siemens.

2. Enclosure shall be NRTL listed according to UL 50 or UL 50E.

3. Construct enclosure of steel.

4. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

a. Exterior color shall be manufacturer's standard.
b. Interior color shall be manufacturer's standard.

5. Hinged door full size of front face of enclosure.

6. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.

7. Internal panel mounting hardware, grounding hardware and sealing washers.
8. Grounding stud on enclosure body.
9. Thermoplastic pocket on inside of door for record Drawings and Product Data.

2.4 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.

1. Wire size shall be at least No. 18 AWG.
2. Conductor shall be 7/24 soft annealed copper strand with 50- to 65-mm (2- to 2.5-inch) lay.
3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
4. Conductor colors shall be black (hot), white (neutral), and green (ground).
5. Furnish wire on spools.

B. Single Twisted Shielded Instrumentation Cable above 24 V:

1. Wire size shall be a minimum No. 18 AWG.
2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 50- to 65-mm (2- to 2.5-inch) lay.
3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
5. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
6. Furnish wire on spools.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:

1. Wire size shall be a minimum No. 22 AWG.
2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 50- to 65-mm (2- to 2.5-inch) lay.
3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC, plenum rated.
4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
   a. Shielding for wiring in conduit mat be omitted at Contractor's option.
5. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable, plenum rated.
6. Furnish wire on spools.

D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.

1. Cable shall be plenum rated.
2. Cable shall comply with NFPA 70.
3. Cable shall have a unique color that is different from other cables used on Project.
4. Copper Cable for Ethernet Network:

   a. 1000BASE-T.
   b. TIA/EIA 586, Category 6.
   c. Minimum No. 22 AWG solid.
   d. Shielded Twisted Pair (STP) or Unshielded Twisted Pair (UTP).
   e. Thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, Class CMP as plenum rated.

2.5 RACEWAYS FOR CONTROL WIRING, AND CABLING

A. Metal Conduits, and Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit; a Tyco International Ltd. Co.
   b. Electri-Flex Company.
   c. O-Z/Gedney; a brand of EGS Electrical Group.
   d. Thomas& Betts Corporation.
   e. Wheatland Tube Company; a division of John Maneely Company.

2. Listing and Labeling: Metal conduits, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. GRC: Comply with NEMA ANSI C80.1 and UL 6.

4. EMT: Comply with NEMA ANSI C80.3 and UL 797.
   a. Color: Blue, factory finish.
5. FMC: Comply with UL 1; zinc-coated steel.
6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

7. Fittings for Metal Conduit: Comply with NEMA ANSI FB 1 and UL 514B.

    a. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
    b. Fittings for EMT:

        1) Material: Steel.
        2) Type: Set-screw.

    c. Expansion Fittings: Steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

B. Nonmetallic Conduits, and Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. CANTEX INC.
    b. FRE Composites.
    c. Lamson & Sessions.
    d. Thomas & Betts Corporation; a member of the ABB Group.

2. Listing and Labeling: Nonmetallic conduits, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. RNC: Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
4. Fittings for RNC: Comply with NEMA TC 3; match to conduit type and material.
5. Emissions for wet-applied solvent cements, adhesives, adhesive primers: Comply with low emission requirements in Division 01 Section “Sustainable Design Requirements.”

C. Metal Wireways and Auxiliary Gutters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cooper B-line, Inc.
    b. Hoffman; a brand of Pentair company.
    c. MonoSystems, Inc.
    d. Square D; a brand of Schneider Electric.

2. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 12 unless otherwise indicated, and sized according to NFPA 70.

    a. 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.

3. 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.
4. Wireway Covers: Hinged type unless otherwise indicated.
5. Finish: Manufacturer's standard enamel finish.

D. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color as selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MonoSystems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

2.6 CONTROL POWER WIRING AND RACEWAYS

A. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables" electrical power conductors and cables.

B. Comply with requirements in Division 26 Section "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

2.7 IDENTIFICATION

A. Control Equipment, Instruments, and Control Devices:

1. Engraved tag bearing unique identification.

a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.

2. Letter size shall be as follows:

a. DDC Controllers: Minimum of 13 mm (0.5 inch) high.
b. Gateways: Minimum of 13 mm (0.5 inch) high.
c. Repeaters: Minimum of 13 mm (0.5 inch) high.
d. Enclosures: Minimum of 13 mm (0.5 inch) high.
e. Electrical Power Devices: Minimum of 6 mm (0.25 inch) high.
f. Accessories: Minimum of 6 mm (0.25 inch) high.
g. Instruments: Minimum of 6 mm (0.25 inch) high.

3. Tag shall consist of white lettering on black background.
4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer.
5. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

B. Raceway and Boxes:

1. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.

C. Equipment Warning Labels:

1. Acrylic label with pressure-sensitive adhesive back and peel-off protective jacket.
2. Lettering size shall be at least 14-point type with white lettering on red background.
3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 6 mm (0.25 inch) beyond white border.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.

1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROL DEVICES FOR EQUIPMENT MANUFACTURER FACTORY INSTALLATION

A. Deliver the following to air-handling unit manufacturer for factory installation. Include installation instructions to air-handling unit manufacturer.

1. Unit-mounted flow and pressure switches. Air and liquid flow sensors, transmitters, and transducers are specified in Division 23 Section "Flow Instruments." Pressure sensors, switches, and transmitters are specified in Division 23 Section "Pressure Instruments."

B. Deliver the following to terminal unit manufacturer for factory installation. Include installation instructions to terminal unit manufacturer.

1. Programmable application or application-specific controller.
2. Electric damper actuator.
3. Unit-mounted flow and pressure sensors, transmitters and transducers.

3.3 TEMPERATURE INSTRUMENT APPLICATIONS

A. Air Temperature Sensors:
1. Space: Thermistor or 1000-ohm platinum RTD.
a. Where temperature and humidity sensors are indicated adjacent to each other, provide combination sensor.
b. Provide digital display in galleries.
c. Provide button sensor for sensors mounted on curtain walls.

3.4 TEMPERATURE INSTRUMENT INSTALLATIONS

A. Mounting Location:

1. Roughing In:

a. Outline instrument mounting locations before setting instruments and routing cable, wiring, and conduit to final location.
b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.

1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
2) Do not begin installation without submittal approval of mounting location.

c. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.

B. Mounting Height:

1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.

C. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

D. Space Temperature Sensor Installation:

1. Conceal assembly in an electrical box of sufficient size to house sensor and transmitter, if provided.
2. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.
3. In finished areas, recess electrical box within wall.

4. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.

3.5 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

G. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

H. Trending: Trend points minimum 30 days prior to commissioning of each Zone or work sub-set.

3.6 POSITION INSTRUMENTS INSTALLATION

A. Mounting Location:

1. Rough-in instrument-mounting locations before setting instruments and routing, cable, wiring, and conduit to final location.
2. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated, using neoprene gaskets or grommets.

3.7 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.

B. Connect controllers to field power supply where indicated.

C. Install controller with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Warning Labels:

1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
2. Shall be located in highly visible location near power service entry points.

3.8 PIPING INSTALLATION

A. Identify piping as follows:

1. Every 15 m (50 feet) of straight run.
2. At least once for each branch within 900 mm (36 inches) of main tee.
3. At each change in direction.
4. Within 900 mm (36 inches) of each ceiling, floor, roof and wall penetration.
5. Where exposed to and where concealed from view, including above ceiling plenums, shafts, and chases.
6. At each valve.
7. Mark each instrument tube connection with a number-coded identification. Each unique tube shall have same unique number at instrument connection and termination at opposite end of tube.

B. Process Tubing Installation:

1. Install process tubing for signal to instruments in liquid and steam systems. Instruments include, but are not limited to, the following:

a. Meters.
b. Sensors.
c. Switches.
d. Transmitters.

2. Support tubing according to MSS SP-69, Table 3, but at intervals no less than 1500 mm (60 inches).
3. Install DN 15 (NPS 1/2) process tubing for industrial-grade sensors, transmitters, and switches. Install stainless-steel bushings where required.
4. Make tubing bends with a bending tool. Flattened or wrinkled bends are unacceptable.
5. Support tubing independent of other trades.
6. Route tubing parallel to and at right angles to building construction.
7. Install tubing concealed in areas with ceilings.
8. Install a dirt leg with an isolation valve and threaded plug in drain valve at each connection to a transmitter and switch.
9. Insulate process piping connected to hot water and steam systems for personnel protection if the surface temperature exceeds 49 deg C (120 deg F). Only insulate piping within maintenance personnel reach from floor, platform, or catwalk.

10. Wrap pipe threads of fitting in process tubing with service temperatures below 177 deg C (350 deg F) with a single wrap of PTFE tape.
11. Coat pipe threads of fittings on process tubing in services with temperatures exceeding 177 deg C (350 deg F) with pipe compound before being made up to reduce the possibility of galling.
12. Do not make tubing connections to a fitting before completing makeup of the connection.
13. Check tubing for correct diameter and wall thickness. Cut the tube ends square and deburred. Exercise care during cutting to keep tubing round.
14. Do not install fittings close to a bend. A length of straight tubing, not deformed by bending, is required for a proper connection.
15. Align tubing with fitting when installed. Avoid springing tube into position.
16. Install tubing with extreme care exercised to keep foreign matter out of system. Open tubing ends shall be kept plugged to keep out dust, dirt and moisture.
17. Do not attach tubing to equipment that may be removed frequently for maintenance or may impart vibration and expansion from temperature change.
18. Protect exposed tubing in mechanical equipment rooms from inadvertent mechanical damage within 2400 mm (96 inches) above floor. Use aluminum channel reversed and secured over tubing to protect tubing from damage.

3.9 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

B. Comply with TIA 568-C.1.

C. Wiring Method: Install cables in raceways except within cabinets and in accessible concealed ceiling spaces where cable trays and j-hooks wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install shielded plenum cable in locations where raceway protection is not provided.
2. Comply with requirements for cable trays specified in Division 26 Section "Cable Trays for Electrical Systems."
3. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceways and Boxes for Electrical Systems.", with noted exceptions below:
   a. Exposed Raceway within 2.1 m (7 feet) of Floor:
      1) Generally: EMT (factory painted blue).
      2) Garage in Loading Dock: GRC.
   b. Exposed Raceway at or above 2.1 m (7 feet) of Floor: EMT (factory painted blue).
   c. Concealed Vertical Raceway: EMT (factory painted blue).
   d. Concealed Inaccessible Horizontal Raceway: EMT (factory painted blue).
   e. Concealed Horizontal Raceway Above Accessible Ceiling (Lay-in): Cable tray or j-hooks.
   f. Concealed Raceway in Demountable Partitions: Low voltage raceway integral with partitions.
   g. Exterior Raceway: GRC.

D. Field Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Conduit Installation:

1. Install conduit expansion joints where conduit runs exceed 60 m (200 feet), and conduit crosses building expansion joints.
2. Coordinate conduit routing with other trades to avoid conflicts with ducts, pipes and equipment and service clearance.
3. Maintain at least 75-mm (3-inch) separation where conduits run axially above or below ducts and pipes.
4. Limit above-grade conduit runs to 30 m (100 feet) without pull or junction box.
5. Do not install raceways or electrical items on any "explosion-relief" walls, or rotating equipment.
6. Do not fasten conduits onto the bottom side of a metal deck roof.
7. Flexible conduit is permitted only where flexibility and vibration control is required.
8. Limit flexible conduit to 1 m (3 feet) long.
9. Conduit shall be continuous from outlet to outlet, from outlet to enclosures, pull and junction boxes, and shall be secured to boxes in such manner that each system shall be electrically continuous throughout.
10. Direct bury conduits underground or install in concrete-encased duct bank where indicated.

    a. Use rigid, nonmetallic, Schedule 80 PVC.
    b. Provide a burial depth according to NFPA 70, but not less than 600 mm (24 inches).

11. Secure threaded conduit entering an instrument enclosure, cabinet, box, and trough, with a locknut on outside and inside, such that conduit system is electrically continuous throughout. Provide a metal bushing on inside with insulated throats. Locknuts shall be the type designed to bite into the metal or, on inside of enclosure,.
12. Conduit box-type connectors for conduit entering enclosures shall have an insulated throat.
13. Connect conduit entering enclosures in wet locations with box-type connectors or with watertight sealing locknuts or other fittings.
14. Offset conduits where entering surface-mounted equipment.
15. Seal conduit runs used by sealing fittings to prevent the circulation of air for the following:

    a. Conduit extending from interior to exterior of building.
    b. Conduit extending into pressurized duct and equipment.
    c. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.

F. Wire and Cable Installation:

1. Cables serving a common system may be grouped in a common raceway. Install control wiring and cable in separate raceway from power wiring. Do not group conductors from different voltages.
2. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C (194 deg F) with no measurable effect on physical and electrical properties of cable.

a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.

3. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
5. UTP Cable Installation:

   a. Comply with TIA 568-C.2.
   b. Do not untwist UTP cables more than 12 mm (1/2 inch) from the point of termination, to maintain cable geometry.

6. Installation of Cable Routed Exposed under Raised Floors:

   a. Install plenum-rated cable only.
   b. Install cabling after the flooring system has been installed in raised floor areas.
   c. Coil cable 1.8 m (6 feet) long not less than 300 mm (12 inches) in diameter below each feed point.

7. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.
8. Provide strain relief.
9. Terminate wiring in a junction box.

   a. Clamp cable over jacket in junction box.
   b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.

10. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
11. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
12. Keep runs short. Allow extra length for connecting to terminal boards. Do not bend flexible coaxial cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.

    a. Runs to sensors mounted in Galleries: Provide 15 m (50 feet) of cable slack, to permit future relocation of sensors without splicing.

13. Ground wire shall be copper and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.
14. Wire and cable shall be continuous from terminal to terminal without splices.
15. Use shielded cable to transmitters when not in raceway.
16. Use shielded cable to temperature sensors when not in raceway.
17. Do not install bruised, kinked, scored, deformed, or abraded wire and cable. Remove and discard wire and cable if damaged during installation, and replace it with new cable.
18. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

19. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
20. Protection from Electro-Magnetic Interference (EMI): Provide installation free of (EMI). As a minimum, comply with the following requirements:

    a. Comply with BICSI TDMM and TIA 569-C for separating unshielded cable from potential EMI sources, including electrical power lines and equipment.
    b. Separation between open cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

        1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 127 mm (5 inches).
        2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 300 mm (12 inches).
        3) Electrical Equipment Rating More Than 5 kVA: A minimum of 610 mm (24 inches).

    c. Separation between cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

        1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 64 mm (2-1/2 inches).
        2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 150 mm (6 inches).
        3) Electrical Equipment Rating More Than 5 kVA: A minimum of 300 mm (12 inches).

    d. Separation between cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

        1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
        2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 76 mm (3 inches).
        3) Electrical Equipment Rating More Than 5 kVA: A minimum of 150 mm (6 inches).

    e. Separation between Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 1200 mm (48 inches).
    f. Separation between Cables and Fluorescent Fixtures: A minimum of 127 mm (5 inches).

3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Testing:

1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.
2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.
3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.
4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.
5. Test Equipment: Use a fiber-optic time domain reflectometer for testing of length and optical connectivity.
6. Test Results: Record test results and submit copy of test results for Project record.

3.11 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:

    a. Verify sensing element type and proper material.
    b. Verify length and insertion.

3.12 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 230923

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Refrigerant pipes and fittings.
2. Refrigerant piping valves and specialties.
3. Refrigerants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and piping specialty.

1. Include pressure drop, based on manufacturer's test data, for the following:

a. Valves.
b. Moisture/liquid indicators.
c. Filter dryers.

B. Shop Drawings:

1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
2. Show interface and spatial relationships between piping and equipment.
3. Shop Drawing Scale: 1/4 inch equals 1 foot**.**

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

B. Field quality-control reports to include in maintenance manuals submittal.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-134a:

1. Suction Lines for Air-Conditioning Applications: 115 psig (793 kPa).
2. Suction Lines for Heat-Pump Applications: 225 psig (1551 kPa).
3. Hot-Gas and Liquid Lines: 225 psig (1551 kPa).

B. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B), or ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8/A5.8M.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Danfoss Inc.
    b. Heldon Products; Henry Technologies.
    c. Parker Hannifin Corp.
    d. Paul Mueller Company.

2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
4. Operator: Rising stem and hand wheel.
5. Seat: Nylon.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 deg F (135 deg C).

B. Packed-Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Danfoss Inc.
    b. Heldon Products; Henry Technologies.
    c. Parker Hannifin Corp.
    d. Paul Mueller Company.

2. Body and Bonnet: Forged brass or cast bronze.
3. Packing: Molded stem, back seating, and replaceable under pressure.

C. Service Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Danfoss Inc.
    b. Emerson Climate Technologies.
    c. Heldon Products; Henry Technologies.
    d. Parker Hannifin Corp.
    e. Paul Mueller Company.
    f. Refrigeration Sales, Inc.

2. Body: Forged brass with brass cap including key end to remove core.
3. Core: Removable ball-type check valve with stainless-steel spring.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Copper spring.
6. Working Pressure Rating: 500 psig (3450 kPa).

D. Moisture/Liquid Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.

2. Body: Forged brass.

3. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
4. Indicator: Color coded to show moisture content in parts per million (ppm).
5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
6. End Connections: Socket or flare.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 240 deg F (116 deg C).

E. Permanent Filter Dryers: Comply with AHRI 730.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Danfoss Inc.
   b. Emerson Climate Technologies.
   c. Heldon Products; Henry Technologies.
   d. Parker Hannifin Corp.

2. Body and Cover: Painted-steel shell.

3. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Desiccant Media: Activated aluminum or charcoal.
5. Designed for reverse flow (for heat-pump applications only).
6. End Connections: Socket.
7. Access Ports (for suction-line filter dryers): NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: **2 psig (14 kPa)**
9. Working Pressure Rating: 500 psig (3450 kPa).
10. Maximum Operating Temperature: 240 deg F (116 deg C).

2.4 REFRIGERANTS

A. ASHRAE 34, R-134a: Tetrafluoroethane.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Arkema Inc.
   b. DuPont Fluorochemicals Div.

c. Genetron Refrigerants; Honeywell International Inc.
d. Mexichem Fluor Inc.

B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arkema Inc.
b. DuPont Fluorochemicals Div.
c. Genetron Refrigerants; Honeywell International Inc.
d. Mexichem Fluor Inc.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT

A. Suction Lines NPS 2 (DN 90) and smaller for Conventional Air-Conditioning Applications: Copper, Type ACR or Type L (B), drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines:
1. NPS 1-1/4 (DN 32) and Smaller: Copper, Type ACR, Type K (A), or Type L (B), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
2. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): Copper, Type ACR, Type K (A), or Type L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

D. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

E. Install flexible connectors at or near compressors.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are required for proper operation and approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:

1. DN 15 (NPS 1/2): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod, 1/4 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod, 1/4 inch (6.4 mm).
4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod, 3/8 inch (9.5 mm).
7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod, 3/8 inch (9.5 mm).
8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod, 3/8 inch (9.5 mm).
9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod, 1/2 inch (13 mm).

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Sealant and gaskets.
5. Hangers and supports.

B. Related Sections include the following:

1. Division 01 Sustainability Sections for additional requirements related to the LEED certification process.
2. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
3. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes.
4. Division 23 Section “Flexible Ducts” for flexible ducts.
5. Division 23 Section “Vibration Controls for HVAC” for flexible duct connectors.

1.4 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, whichever is more stringent.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.
2. Round and flat oval duct and fittings.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
4. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."
5. Product Data for EQ Credit Low-Emitting Materials: Documentation for wet-applied adhesives and sealants, indicating compliance with California Department of Public Health (CDPH) Standard Method v1.1-2010 including printed statement of VOC content in g/L.

C. Shop Drawings:

1. Drawings Scale: 50:1 (1/4 inch per foot).
2. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
3. Factory- and shop-fabricated ducts and fittings.
4. Duct layout indicating sizes, configuration, and static-pressure classes.
5. Elevation of top of ducts.
6. Dimensions of main duct runs from building grid lines.
7. Fittings.
8. Reinforcement and spacing.
9. Seam and joint construction.
10. Penetrations through fire-rated and other partitions.
11. Equipment installation based on equipment being used on Project.
12. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
13. Hangers and supports, including methods for duct and building attachment and vibration isolation.
14. Provide Shop Drawings for entire project.
15. Refer to Division 23 Section “Common Work Results for Mechanical” for coordination drawing requirements.

D. 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.

E. Field quality control test reports.

F. Duct cleanliness reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," 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.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. Mockups:

1. Before installing duct systems, build mockups representing static-pressure classes in excess of 750 Pa (3-inch wg) Build mockups to comply with the following requirements, using materials indicated for the completed Work:

a. Five transverse joints.
b. One access door(s).
c. Two typical branch connections, each with at least one elbow.
d. Two typical flexible duct or flexible-connector connections for each duct and apparatus.
e. One 90-degree turn(s) with turning vanes.
f. One fire damper(s).
g. Perform leakage tests specified in "Field Quality Control" Article. Revise mockup construction and perform additional tests as required to achieve specified minimum acceptable results.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver duct with ends sealed. Maintain end caps through shipping, storage, and handling to prevent entrance of dirt, debris, and moisture.

B. Ducts delivered to the job site shall be stored under roof or other approved covering, on pedestals above the ground. Enclosures for ducts shall be weatherproof.

C. Implement an Indoor Air Quality (IAQ) management plan for construction that complies with LEED IEQ Credit 3.1: Construction Indoor Air Quality Management Plan - During Construction

PART 2 - PRODUCTS

2.1 SINGLE-WALL 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. Formed-On and Slip-On 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 SINGLE-WALL ROUND AND FLAT-OVAL 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, provide products by one of the following:

a. Ductmate Industries, Inc.
b. Linx Industries (formerly Lindab).
c. McGill AirFlow LLC.
d. MKT Metal Manufacturing.
e. SEMCO LLC.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. 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 1524 mm (60 Inches) in Diameter: Flanged.

D. 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 2286 mm (90 inches) in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 1830 mm (72 inches) in width (major dimension) with butt-welded longitudinal seams.

E. 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: Z180 (G60) for round and flat oval ducts, Z275 (G90) for rectangular ducts.
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 209M (ASTM B 209) 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, 10-mm (3/8-inch) minimum diameter.

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: (152 mm) 6 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 2500 Pa (10-inch wg), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 93 deg C (Minus 40 to plus 200 deg F).
9. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum.
10. Interior wet-applied sealants: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and VOC not to exceed 420 g/L.

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. Interior wet-applied sealants: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and VOC not to exceed 420 g/L.
7. Maximum Static-Pressure Class: 2500 Pa (10-inch wg), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.

7. Mold and mildew resistant.
8. Interior wet-applied sealants: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and VOC not to exceed 420 g/L.
9. Maximum Static-Pressure Class: 2500 Pa (10-inch wg), positive or negative.
10. Service: Indoor or outdoor.
11. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

E. 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. Interior wet-applied sealants: Comply with California Department of Public Health (CDPH) Standard Method v1.1-2010 and VOC not to exceed 420 g/L.

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 0.14 L/s per sq. m at 250 Pa (3 cfm/100 sq. ft. at 1-inch wg) and shall be rated for 2500-Pa (10-inch wg) 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 5-1M (Table 5-1), "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 SOURCE QUALITY CONTROL

A. Duct Fabrication: Protect duct interiors from moisture, shop 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."

1. Cleanliness Level: Advanced.
2. Seal ends of ductwork and air devices with plastic as they are fabricated. In no case shall a duct be left open ended.

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 and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 25 mm (1 inch), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 38 mm (1-1/2 inches).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, a3.1.L nd other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

1. Cleanliness Level: Advanced.
2. Seal ends of ductwork and air devices with plastic as they are installed. In no case shall a duct be left open ended.
3. Once systems are placed in operation, provide temporary filters at each return air inlet and at each AHU until final acceptance by COTR. Refer to Division 23 Section “Particulate Air Filtration.”

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR PAINT SPRAY BOOTH EXHAUST DUCT

A. Install paint spray booth exhaust duct without dips and traps that may hold water, and sloped a minimum of 2 percent to low point drains.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 6 m (20 feet**)** in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

1. Locate access panels at duct sprinkler heads.
2. Locate access panels in side of ducts.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 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. Generally: Seal Class A
2. Transfer Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Insulation shall be continuous at hangers and supports.

C. 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 100 mm (4 inches) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 100 mm (4 inches) thick.

D. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1M (Table 5-1), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 610 mm (24 inches) of each elbow and within 1200 mm (48 inches) of each branch intersection.

E. Hangers Exposed to View: Threaded rod and angle or channel supports.

F. 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 maximum intervals of 5 m (16 feet).

G. 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.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 Section “Painting and Coating.”

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual" and as specified herein, whichever is more stringent. Submit a test report for each test.
2. Maximum Allowable Leakage:

    a. Round and Flat Oval Ducts: SMACNA Leakage Class 3.
    b. Rectangular Ducts:

        1) Minus 500 Pa to positive 500 Pa (minus 2-inch to positive 2-inch w.g.): SMACNA Leakage Class 12.
        2) 750 Pa positive and negative (3-inch w.g., positive and negative): SMACNA Leakage Class 6.
        3) Negative 1000 Pa and less, and Positive 1000 Pa and greater (negative 4-inch w.g. and less, and positive 4-inch w.g. and greater): SMACNA Leakage Class 3.

3. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 500 Pa (2-Inch wg): Test all duct sections.
    b. Ducts with a Pressure Class of (500 Pa) 2-Inch wg or Lower: Test representative duct sections**,** selected by COTR from sections installed**,** totaling no less than 10 percent of total installed duct area for each designated pressure class.

4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advance notice for testing.
8. Tests shall be witnessed by teat and balance contractor, commissioning agent, COTR, and construction manager.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by COTR, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

3. If Acceptable Cleanliness Level is not achieved, clean all ductwork.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean new duct system(s) and air handing units if Duct System Cleanliness Tests reveal Acceptable Cleanliness Level is not achieved.

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 as recommended manufacturer. Comply with Division 23 Section "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, or duct accessories.
4. 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.
5. Provide drainage and cleanup for wash-down procedures.
6. 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.

F. Cleanliness Verification: Retest Duct System Cleanliness. Reclean and retest ductwork until Duct System Cleanliness Tests reveal Acceptable Cleanliness Level is achieved.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Static-Pressure and Seal Classes: Unless otherwise indicated on the drawings, construct ducts according to the following:

DUCT SYSTEM	SMACNA PRESSURE CLASS (INCHES WG)	GAGE PRESSURE	SMACNA SEAL CLASS (Note 1)
Supply ducts, generally	2” (500 Pa)	Positive	A
Supply ducts downstream of FCUs, CUHs, and CRACs, generally	1” (250 Pa)	Positive	A
Supply ducts downstream of FCU-50	2” (500 Pa)	Positive	A
Supply ducts downstream of supply air terminal units	2” (500 Pa)	Positive	A
Supply duct between AHU-2, AHU-6, AHU-11, AHU-16, and AHU-21 discharge and first floor slab	3” (750 Pa)	Positive	A
Supply duct between AHU-9 discharge and mechanical room wall	3” (750 Pa)	Positive	A
Supply duct between AHU-4, AHU-20, and AHU-24 through AHU-29 discharge and supply air terminal unit inlets	4” (1000 Pa)	Positive	A
Supply duct between AHU-23 discharge and mechanical; room wall	6” (1500 Pa)	Positive	A
AHU-23 supply duct between mechanical room wall and supply air terminal unit inlets	4” (1000 Pa)	Positive	A
Return ducts, generally	2" (500 Pa)	Negative	A
Return ducts upstream of FCUs, CUHs, and CRACs, generally	1” (250 Pa)	Negative	A
Return ducts within 15 m (50 feet) of FCU-14, FCU-31 and FCU-50 inlet	2” (500 Pa)	Negative	A
Return ducts between first floor slab and AHU-1, AHU-3, and AHU-5 inlet	3” (750 Pa)	Negative	A
Return ducts between mechanical room wall and AHU-2, AHU-6, and AHU-21 inlet	3” (750 Pa)	Negative	A
Relief ducts from AHU discharges to outdoors, generally	2” (500 Pa)	Positive	A
Relief ducts from AHU discharges to ERV inlets	2” (500 Pa)	Negative	A
Exhaust ducts, generally.	2” (500 Pa)	Negative	A
Exhaust ducts from exhaust fan and ERV discharges to outdoors.	2” (500 Pa)	Positive	A
Exhaust ducts between air device inlets and exhaust air terminal unit inlets	2” (500 Pa)	Negative	A
Exhaust ducts between exhaust air terminal unit outlets and ERV-10 inlet, and from ERV-10 outlet to EF-2 inlet.	4” (1000 Pa)	Negative	A
Outdoor air ducts from outdoors to unit inlets, generally	2” (500 Pa)	Neg	A

DUCT SYSTEM	SMACNA PRESSURE CLASS (INCHES WG)	GAGE PRESSURE	SMACNA SEAL CLASS (Note 1)
Outdoor air ducts within 3 m (10 feet) of ERV-6 inlet and within 3 m (10 feet) of AHU-23 maximum outside air inlet	3" (750 Pa)	Neg	A
Pretreated outdoor air from ERV discharge to AHU outside air inlets	2" (500 Pa)	Pos or Neg	A
Transfer air ducts, generally	1" (250 Pa)	Negative	C
Transfer air ducts, upstream of transfer fans	1" (250 Pa)	Negative	B
Transfer air ducts, downstream of transfer fans	1" (250 Pa)	Positive	B

Notes 1. Provide Seal Class A for ducts in all locations except transfer ducts.

B. All ducts shall be galvanized steel except as follows:

1. Paint spray booth exhaust shall be carbon steel with welded joints.
2. Stainless steel ducts for duct-mounted humidifiers.

C. Tie Rods:

1. Tie rods or other type of intermediate or joint duct reinforcement shall not be used in ducts with longest side less than 787 mm (31 inches).
2. Where tie rod connections penetrate ductwork, neoprene backed galvanized washers shall be used to seal penetrations airtight.
3. Where tie rods are in double wall ductwork, seal edges of inner duct penetrations.
4. Tie rods at each joint and at intermediate points shall align to minimize air turbulence.

D. Rectangular Transverse Joints:

1. Generally: Prefabricated slide-on joints or formed-on flanges.

   a. Manufacturer recommended size, spacing, joining methods, sealant, and joint reinforcement.
   b. Minimum sheet metal gauges shall conform to both Rectangular Duct Reinforcement Tables and Transverse Joint Reinforcement Table.
   c. Cleats or clips as manufactured for the specific purpose of joining adjacent flanges shall be utilized in conjunction with transverse joints; sheet metal screws alone are not acceptable for joining flanges.

2. Slip-and-Drive Joints may be utilized for transfer ducts and ducts with sides less than 13 mm (6 inch), at Contractor's option.

E. Rectangular Longitudinal Seams:

1. Pressure Classes Minus 500 Pa (2-inch) to Plus 500 Pa (2-inch w.g).: Snap-loc with internal joint sealed.

2. Pressure Classes Plus or Minus 750 Pa (3-inch) to 2500 Pa (10-inch w.g.): Pittsburgh lock with internal joint sealed.

F. All round and flat oval ducts shall be spiral lock-seam type.

1. At Contractor's option, spiral lockseam duct with standing rib construction may be utilized for concealed positive low pressure (+(0 to 500 Pa) 0 to 2 inch w.g.).
2. At Contractor's option, when concealed from finished spaces, up to 3 m (10 linear feet) of longitudinal seam duct may be utilized in low pressure (negative 500 to positive 500 Pa (negative 2-inch w.g. to positive 2-inch w.g.)) systems, between taps and diffusers, provided longitudinal seam is sealed.

G. Round and Flat Oval Fitting Seams:

1. Spot welded, tack welded, or gore-lock and sealed with a specified sealant for pressure classes from minus 500 Pa to plus 500 Pa (minus 2-inch wg to plus 2-inch wg,) unless otherwise indicated.
2. Continuously or stitch welded for pressure classes from plus or minus 750 Pa to 2500 Pa (3-inch wg to 10-inch wg,) unless otherwise indicated.

H. Round and Flat Oval Duct Transverse Joints:

1. Round Ducts up to 610 mm (24 Inches) in Diameter: Interior, center-beaded slip coupling, sealed if doubled lipped EPDM gasketed fittings are not used, attached with sheet metal screws.

    a. Contractor Option: refabricated connection system consisting of double-lipped, EPDM rubber gasket may be used. Manufacture ducts according to connection system manufacturer's tolerances.

2. Round Ducts 635 mm to 1829 mm (25 to 72 Inches) in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Round Ducts Larger Than 1829 mm (72 Inches) in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

I. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts:

    a. Exposed to Airstream: Match duct material.
    b. Not Exposed to Airstream: Galvanized.

3. Aluminum Ducts: Aluminum.

J. Double-Wall Duct Interstitial Insulation:

1. Supply Air Ducts: 50 mm (2 inches thick).

a. Ducts in public spaces may have interstitial insulation thickness of 25 mm (1 inch).

2. Return Air Ducts: 50 mm (2 inches thick).

a. Ducts in public spaces may be single wall, without insulation.

3. Exhaust Air Ducts: 25 mm (1 inch thick).

K. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity (7.6 m/s) (1500 fpm) and Less:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.75 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with single width 50 mm (2 inch) diameter radius on 38 mm (1-1/2 inch centers) 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."

b. Velocity (7.6 m/s) (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 single width 50 mm (2 inch) diameter radius on 38 mm (1-1/2 inch centers) 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. Round and Flat Oval 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 Less Than 7.6 m/s (1500 fpm): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
2) Velocity 7.6 m/s (1500 fpm) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

b. Round Elbows, 305 mm (12 Inches) and Smaller in Diameter: Stamped or pleated.

c. Round Elbows, 356 mm (14 Inches) and Larger in Diameter: Welded.

L. 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: Conical spin in.

2. Round and Flat Oval: 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."

a. Velocity 5 m/s (1000 fpm) or Lower: 90-degree tap.
b. Velocity 5 to 7.6 m/s (1000 to 1500 fpm): Conical tap.
c. Velocity 7.6 m/s (1500 fpm) or Higher: 45-degree lateral.

M. Transitions and Offsets: Maximum 30 degrees; 15 degrees where space permits.

END OF SECTION 233113

SECTION 233300 - AIR DUCT 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 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Backdraft dampers.
3. Flange connectors.
4. Turning vanes.
5. Duct-mounted access doors.
6. Duct accessory hardware.

B. Related Sections include the following:

1. Division 23 Section “Vibration Controls for HVAC” for duct flexible connectors.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop, regenerated noise, and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Sustainable Design Submittals:

1. Product data showing compliance with ASHRAE 62.1.

C. 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. Wiring Diagrams: For power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals submittal.

B. Maintenance Materials: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 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: Z275 (G90).
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.

C. Aluminum Sheets: Comply with ASTM B 209M (ASTM B 209), 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 221M (ASTM B 221), 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, 10-mm (3/8-inch) minimum diameter.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Warming and Ventilating; a Mestek Architectural Group company.
    b. Flexmaster U.S.A., Inc.
    c. McGill AirFlow LLC.
    d. Nailor Industries Inc.
    e. Pottorff.
    f. Ruskin Company.
    g. Trox USA Inc.
    h. Vent Products Co., Inc.

2. Shop Fabrication: Permitted for single blade dampers only.
3. Standard leakage rating, with linkage outside airstream.
4. Suitable for horizontal or vertical applications.
5. Frames:

    a. Frame: Hat-shaped, 2.4-mm- (0.094-inch-) thick, galvanized sheet steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 1.62 mm (0.064 inch) thick.

7. Blade Axles: Galvanized steel.
8. Bearings:

    a. Oil-impregnated bronze.
    b. Dampers in ducts with pressure classes of 750 Pa (3-inch wg) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Tie Bars and Brackets: Galvanized steel.
10. Size: 13-mm (0.5-inch) diameter.
11. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

12. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

B. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 2.4-mm- (3/32-inch-) thick zinc-plated steel, and a 19-mm (3/4-inch) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 BACKDRAFT DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.
5. Vent Products Co., Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 5.1 m/s (1000 fpm).

D. Maximum System Pressure: 0.25 kPa (1-inch wg).

E. Frame: Hat-shaped, 1.3-mm- (0.05-inch-) thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, center pivoted, maximum 150-mm (6-inch) width, 0.6-mm- (0.025-inch-) thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Galvanized steel.
2. Diameter: 5 mm (0.20 inch).

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.

2. Chain pulls.
3. Screen Mounting: Rear mounted.
4. Screen Material: Aluminum.
5. Screen Type: Bird.
6. 90-degree stops.

2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Hardcast, Inc.
4. Nexus PDQ.
5. Ward Industries; a brand of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, 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, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Elgen Manufacturing.
5. Ward Industries; a brand 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. Shop-fabricated turning vanes are permitted.

C. 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."

D. Vane Construction: Single wall with 25 mm (2 inch) radius and 38 mm (1-1/2 inch) spacing.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.

2. Ductmate Industries, Inc.
3. Flexmaster U.S.A., Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. Nailor Industries Inc.
7. Ventfabrics, Inc.
8. Ward Industries; a brand of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors:

1. Oval Door: Standard bolted access door: Oval outer door connected to an inner plate by spring loaded carriage bolts, with hand knobs for tightening, inert cellular sponge gasket, and permanently bonded polyester insulation (to prevent moisture from forming on outer surface; leak free at 5000 Pa (20 inch w.g.) static pressure.; equal to McGill Airflow Corporation model AOBXFS.
2. Round Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.

    a. Manufacturers:

        1) Ductmate Industries, Inc.
        2) Flexmaster U.S.A., Inc.

    b. Frame: Galvanized sheet steel, with spin-in notched frame.

3. For round ducts too small to locate other specified access doors, provide hinged access doors.

    a. Manufacturers:

        1) Semco.
        2) Approved equal.

    b. Door shall be 20-gauge galvanized steel.
    c. Hinge shall be continuous type.
    d. Latches shall be sash lock type and a minimum of 3 (one on each side, except hinge side) shall be provided.
    e. Gasket provided shall be continuous.
    f. Doors shall be suitable for the pressure class of the duct systems in which they are located.
    g. Externally insulate access doors in insulated duct systems. Insulation shall be equal to type and thickness specified for the duct system in Division 23, Section “Mechanical Insulation.”
    h. Hinged access doors shall be equal to Semco type S40

2.8 ROUND TAKEOFF FITTINGS

A. Manufacturers:

1. Flexmaster U.S.A., Inc.
2. Approved equal.

B. Provide integral locking hand quadrant type volume damper where indicated or where round takeoff fittings are located at round duct branches serving air devices. Volume damper shall be complete with standoff for minimum 1-1/2-inch insulation, square shaft, U-bolt, nylon or rubber bushings, locking quadrant, and damper blade.

C. Seal fittings as follows:

1. Spot or tack welded and sealed with a specified sealant for pressure classes from minus 500 Pa to plus 500 Pa (minus 2-inch wg to plus 2-inch w.g.), unless otherwise indicated.
2. Continuously welded or stitch-welded for pressure classes from plus 500 Pa to 2500 Pa (2-inch wg to 10-inch wg), unless otherwise indicated.

D. Conical and Bell Mouth Fittings:

1. Spin-in or flanged type.
2. Constructed of a two-piece 26-gauge G-90 galvanized steel body and factory sealed for high pressure applications.
3. Overall length of the fitting shall be 150mm (6”) without damper and 250mm (10”) with damper.
4. Round outlet shall be provided with a rolled stiffener bead for strength and ease of installation and sealing of spiral and flexible ductwork joints.
5. Conical fittings shall be equal to Flexmaster Model CB.

E. Flared Fittings:

1. Spin-in type.
2. Constructed of 26 gauge G-90 galvanized steel.
3. Overall length of the fitting shall be 75 mm (3”) without damper and 175 mm (7”) with damper.
4. Round outlet shall be provided with a rolled stiffener bead for strength and ease of installation and sealing of spiral and flexible ductwork joints.
5. Flared fittings shall be equal to Flexmaster Model FL.

F. Side takeoff Fittings:

1. Maintain a ratio of 1:1 of inlet to outlet on units over 175 mm (7”) diameter to allow proper sizing of the duct system.
2. Incorporate a 45-degree rectangular entry to minimize pressure drop.
3. Include a 25 mm (1”) wide pre-punched mounting flange with corner clips and adhesive gasket for minimal leakage and ease of installation.
4. Constructed of a two-piece 26-gauge G-90 galvanized steel body and collar.
5. Overall length of the fitting shall be 330 (13”) with or without damper to reduce turbulence in the airstream.
6. Round outlet shall be provided with a rolled stiffener bead for strength and ease of installation and sealing of spiral and flexible ductwork joints.
7. Side takeoff fittings shall be equal to Flexmaster Model STO.

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. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. 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 galvanized steel volume dampers in galvanized steel ducts.
2. Install stainless steel volume dampers in stainless steel ducts.
3. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install duct oval or round access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. Duct-mounted control devices.
2. Elsewhere as indicated.
3. As required for duct cleaning.
4. On sides of ducts where adequate clearance is available.

G. Install access doors with swing against duct static pressure.

H. Oval Access Door Minimum Sizes:

1. One-Hand or Inspection Access: 200 by 125 mm (8 by 5 inches).
2. Two-Hand Access: 300 by 150 mm (12 by 6 inches).

3. Head and Hand Access: 460 by 250 mm (18 by 10 inches).
4. Head and Shoulders Access: 530 by 355 mm (21 by 14 inches).
5. Body Access: 635 by 355 mm (25 by 14 inches).
6. Body plus Ladder Access: 635 by 430 mm (25 by 17 inches).

I. Round Access Door Minimum Sizes:

1. One-Hand or Inspection Access: 200 mm (8 inches).
2. Two-Hand Access: 250 mm (10 inches).
3. Head and Hand Access: 300 mm (12 inches).
4. Head and Shoulders Access: 450 mm (18 inches).
5. Body Access: 600 mm (24 inches).

J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. Provide round takeoff fitting where round ductwork takes off from rectangular ductwork in accordance with the following:

1. Provide conical or bell mouth-type fittings where the rectangular duct size is at least 75 mm (3-inches) larger than the round takeoff.
2. Provide flared-type fittings where the rectangular duct size is 50 mm (2-inches) larger than the round takeoff size.
3. Provide side takeoff fittings where rectangular duct size is within 50 mm (2-inches) of the round takeoff size.
4. For final run-out to diffusers, a straight tap may be used at Contractor’s option.

M. Install duct test holes where required for testing and balancing purposes.
N. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 6-mm (1/4-inch) movement during start and stop of fans.

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, smoke, and combination 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.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section Includes:

1. Insulated flexible ducts.

B. Related Sections include the following:

1. Division 01 Sustainability Sections for additional requirements related to the LEED certification process.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product data showing compliance with ASHRAE 62.1.
2. Product Data: For insulation, indicating that R-values comply with tables in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."

C. Shop Drawings: For flexible ducts.

1. Include plans showing locations and mounting and attachment details.

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.

C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. Flex-Tek Group.
3. JP Lamborn Co.
4. McGill AirFlow LLC.
5. Ward Industries; a brand of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, acoustically transparent polyethylene film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 2500 Pa (10-inch wg) positive and 250 Pa (1.0-inch wg) negative.
2. Maximum Air Velocity: 20 m/s (4000 fpm).
3. Temperature Range: Minus 23 to plus 71 deg C (Minus 10 to plus 160 deg F).
4. Insulation R-Value: Comply with ASHRAE/IES 90.1.
5. Acoustic Performance: Insertion loss for 1.8 m (6-feet) of straight 152 mm (6-inch) diameter duct:

125	250	500	1000	2000	4000
5	16	18	17	16	13

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 75 through 460 mm (3 through 18 inches), to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts 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 in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect diffusers or light troffer boots to ducts directly or with maximum 1500-mm (60-inch) lengths of flexible duct clamped or strapped in place.

D. Connect flexible ducts to metal ducts with draw bands.

E. Install duct test holes where required for testing and balancing purposes.

F. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

G. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 38 mm (1-1/2 inches) wide or wider and spaced a maximum of 1200 mm (48 inches) apart. Maximum centerline sag between supports shall not exceed 13 mm (1/2 inch) per 300 mm (12 inches).
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 1800 mm (72 inches) o.c.

END OF SECTION 233346

SECTION233423 - HVAC POWER VENTILATORS

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 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section Includes:
   1. In-line centrifugal fans.

B. Related Sections include the following:

   1. Division 01 Sustainability Sections for additional requirements related to the LEED certification process.

1.4 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Fan speed controllers.

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

   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

3. Computational Fluid Dynamics Output: For placement and quantity of garage induction thrust fans.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals submittal.

1.7 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.8 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of equipment supports with actual equipment provided.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS (TYPE IL)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing Corp.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. PennBarry.
5. Twin City.

B. Description: In-line, direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories

C. Housing: Square design constructed of heavy gauge galvanized steel, minimum two removable access panels located perpendicular to motor mounting panel, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
1. Inlet and Outlet Connection: In-line, unless indicated otherwise.

D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Fan Wheels: Aluminum, backward inclined blades welded to aluminum hub.
1. Wheel cone matched to inlet cone.

2. Statically and dynamically balanced.

F. Fan Shafts and Bearings: Precision ground and polished fan shafts, mounted in permanently sealed, lubricated heavy-duty, self aligning pillow block ball bearings with AMCA 9, L_{50} of 200,000 hours at maximum cataloged operating speed.

G. Motors and drives mounted in the airstream, readily accessible for maintenance.

H. Accessories:

1. Disconnect Switch: Nonfusible type, mounted outside fan housing, factory wired.
   a. Motors with Associated Variable Frequency Controllers (VFC): Auxiliary contacts for shutting down remote VFC when disconnect is open.
2. Companion Flanges: For inlet and outlet duct connections.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Equipment Mounting:

1. Install power ventilators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03 Section "Cast-in-Place Concrete."

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and vibration isolation hangers. Vibration-control devices are specified in Division 23 Section "Vibration Controls for HVAC."

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 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. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Verify lubrication for bearings and other moving parts.
6. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
7. Shut unit down and reconnect automatic temperature-control operators.
8. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

B. Replace fan and motor pulleys as required to achieve design airflow.

C. Lubricate bearings.

END OF SECTION 233423

SECTION 233713 - AIR DIFFUSERS, REGISTERS, AND GRILLES

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 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Adjustable blade face grilles.
3. Fixed face grilles.

B. Related Sections include the following:

1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

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. Air Device Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Selection: For air devices with factory-applied color finishes. Actual size of smallest air device indicated.

1.5 SELECTION CRITERIA

A. Air diffusers, registers, and grilles shall be selected for 5 DB lower than the listed Noise Criteria of the Room, for both radiated and discharge sound levels.

B. Refer to Division 23 Section “Common Work Results for Mechanical” for maximum Noise Criteria per space type.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS (TYPE CD AND CR)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carnes Company.
2. Hart & Cooley Inc.
3. Krueger.
4. Nailor Industries Inc.
5. Price Industries.
6. Titus.
7. Tuttle & Bailey.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel.

D. Finish: Baked enamel, color selected by Architect.

E. Face Size: 600 by 600 mm (24 by 24 inches).

F. Face Style: Plaque.

G. Mounting: T-bar.

H. Pattern: Adjustable.

I. Accessories:

1. Directional blow clips where shown on plan.

2.2 GRILLES

A. Fixed Face Grille (Type RGA):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carnes Company.
b. Hart & Cooley Inc.
c. Krueger.
d. Nailor Industries Inc.
e. Price Industries.
f. Titus.

g. Tuttle & Bailey.

2. Material: Steel.
3. Finish: Baked enamel, color selected by COTR.
4. Face Blade Arrangement: Horizontal airfoil; spaced 19 mm (3/4 inch) apart.
5. Face Arrangement: Perforated core.
6. Core Construction: Removable.
7. Frame: 32 mm (1-1/4 inches) wide.
8. Mounting: Countersunk screw.

B. Adjustable Blade Face Grille (Type SGA):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carnes Company.
b. Hart & Cooley Inc.
c. Krueger.
d. Nailor Industries Inc.
e. Price Industries.
f. Titus.
g. Tuttle & Bailey.

2. Material: Steel.
3. Finish: Baked enamel, color selected by COTR.
4. Face Blade Arrangement: Horizontal airfoil, spaced 19 mm (3/4 inch)
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical airfoil, spaced 19 mm (3/4 inch) apart.
7. Frame: 32 mm (1-1/4 inches) wide.
8. Mounting: Countersunk screw.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

B. In addition to complying with all pertinent codes and regulations, all work of this Section shall conform with ADC 1062GRD-84 Test Code for Grilles, Registers and Diffusers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, and in accordance with Manufacturer's written instructions.

B. Outlets and Inlets Locations: 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.

1. Refer to the Architectural floor plans, sections, and reflected ceiling plans for exact location of air devices.
2. For units installed in lay-in ceiling panels, locate units in the center of panel.
3. Where architectural features or other items conflict with installation, notify COTR for a determination of final location.
4. Ceiling diffuser outlets installed in gypsum ceilings shall not be installed with plaster frames. At the Contractor's option for supply ductwork, flexible duct may be used to connect diffuser to main duct. Diffuser and an adequate amount of hard duct must be supported from the building structure prior to connection with flexible duct for installation of diffuser. Coordinate the installation of the air devices with the sequencing of the gypsum ceiling installation.

C. Support diffusers, registers, grilles, and plenums independently of ceiling construction

D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

E. Construct and install duct and plenum connections to diffusers, registers, and grilles in accordance with manufacturer's written instructions.

F. Modify duct systems (transitions, collars, etc.) as required to accommodate actual sizes of grilles, registers, and diffusers.

3.3 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 234100 - PARTICULATE AIR FILTRATION

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 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section Includes:

1. Pleated panel filters.
2. Bulk media.

1.4 DEFINITIONS

A. MERV: Minimum efficiency reporting value.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. Sustainable Design Submittals:

1. Product Data: For ventilation equipment, indicating compliance with ASHRAE 62.1, Section 5 - "Systems and Equipment."

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals submittal.

1. Filter List: Include filter types, sizes, and quantities for each piece of equipment.

B. Maintenance Materials:

1. During Construction: Provide filter media as required for operation of the existing air handling systems throughout construction.
2. At Substantial Completion: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

a. Provide two complete set(s) of filters for each CRAC unit. Refer to other Division 23 sections for additional requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
2. Comply with ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

a. MERV rating shall not take credit for electrostatic charge of media and rating shall be maintained throughout service life of filter.

B. Comply with NFPA 90A and NFPA 90B.

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.

2.2 PLEATED PANEL FILTERS (TYPE PF)

A. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type, disposable air filters with holding frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AAF International.
b. Camfil Farr.
c. Flanders Corporation.
d. Tri-Dim Filter Corporation.

B. Filter Unit Class: UL 900, Class 2.

C. Media: Cotton and synthetic fibers coated with nonflammable adhesive.

1. Separators shall be bonded to the media to maintain pleat configuration.
2. Welded-wire grid shall be on downstream side to maintain pleat.
3. Media shall be bonded to frame to prevent air bypass.

4. Support members on upstream and downstream sides to maintain pleat spacing.

D. Filter-Media Frame: Cardboard frame with perforated metal retainer sealed or bonded to the media.

E. Capacities and Characteristics:

1. Refer to drawings for additional requirements.
2. Minimum Media Surface Area For Nominal 610 mm x 610 mm (24 Inch x 24 Inch) Filter Face Dimension:

a. 25 mm (1 inch) Depth: 0.7 m^2 (7.2 sq. ft.).
b. 50 mm (2 inch) Depth: 1.6 m^2 (17.2 sq. ft.).
c. 100 mm (4 inch) Depth: 2.3 m^2 (24.8 sq. ft).

3. Recommended Final Resistance: 249 Pa (1.0 inches wg).

2.3 BULK MEDIA (TYPE TF)

A. Description: Air-filter media, factory custom cut or rolled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AAF International.
b. Airguard.
c. Camfil Farr.
d. Flanders Corporation.
e. Koch Filter Corporation.

B. Filter Unit Class: UL 900, Class 2.

C. Media: Spun glass, synthetic, or polyester, in a roll or cut into pads.

D. Capacities and Characteristics:

1. Thickness or Depth: 50 mm (2 inches).
2. Maximum or Rated Face Velocity: 3.2 m/s (625 fpm).
3. Arrestance: 85 percent when tested according to ASHRAE 52.2.
4. Initial Resistance: 0.02 Pa (0.25 inches wg) at 2.5 m/s (500 fpm.)
5. Recommended Final Resistance: 249 Pa (1.0 inch wg).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC."

B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

C. Install filters in position to prevent passage of unfiltered air.

D. Coordinate filter installations with CRAC units installations.

E. Filter Requirements During Construction:

1. Refer to Division 01 Sections for requirements.
2. Provide bulk filters on return air ducts opening in the area of construction.

3.2 CLEANING

A. After completing system installation and testing, adjusting, and balancing of air-distribution systems, clean filter housings and install new pre-filter media. Install new final-filter media if pressure drop is more than double the scheduled initial pressure drop.

1. Do not use the pre-filter extra materials specified in the Maintenance Materials Submittal Article for this filter change out.

END OF SECTION 23 4100

SECTION 238123 - COMPUTER-ROOM AIR CONDITIONERS

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 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section includes floor-mounted, computer-room air conditioners.

1.4 DEFINITIONS

A. COP: Coefficient of performance.

B. EER: Energy efficiency ratio.

C. SCR: Silicon controlled rectifier.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include material descriptions, dimensions of individual components and profiles, and finishes for computer-room air-conditioning units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For computer-room air conditioners.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For computer-room air conditioners to include in emergency, operation, and maintenance manuals submittal.

B. Maintenance Materials: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-driven fan.
2. Filters: Two sets of filters for each unit.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of computer-room air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Humidifiers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Control Boards: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. APC by Schneider Electric.
2. Data Aire Inc.
3. Liebert; a brand of Emerson Electric Co.
4. Stulz-ATS.

2.2 PERFORMANCE REQUIREMENTS

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

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

2.3 CEILING-MOUNTED UNITS

A. Description: Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls.

1. Type HD: Horizontal, with ducted inlet and outlet, and DX cooling coil.

B. Cabinet: Galvanized steel serviceable from one side, with baked-enamel finish, insulated with 13-mm- (1/2-inch-) thick duct liner, and mounting bracket attached to the unit.

1. Supply and return collars for ducting in the field.
2. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Supply-Air Fan:

1. Forward curved, double width, double inlet, centrifugal, with adjustable V-belt drive.

a. High static fan for ducted supply and return.
b. Two-speed motor.

D. Refrigeration System: The refrigeration system shall be split consisting of an indoor evaporator and remote air-cooled outdoor condenser. The evaporator and condenser shall be factory assembled and tested. The refrigeration circuit shall be a single circuit system.

1. Indoor Evaporator: The indoor evaporator shall include the cooling coil, compressor(s), filters, reheat and controls. The cooling coil shall be constructed with copper tubes and aluminum fins for maximum heat transfer. The compressor(s) shall be hermetic scroll type, with complete overload protection on all three power lines, internal thermostat for winding protection, crankcase heater(s), Rotolock valve(s), sight-glass(es). The expansion valve(s) shall be of the adjustable thermostatic type with external equalization. The circuit(s) shall contain high and low pressure safety switches. The high and low pressure safety switches are connected to the refrigerant system with a Schrader fitting that allows replacement without affecting the refrigerant charge, making recovery unnecessary. Units with capillary tube metering devices shall not be acceptable. The evaporator section shall be provided with condensate drain pan constructed of stainless steel and provide a positive drain to prevent standing water in the condensate pan
2. Outdoor Condenser: The remote outdoor air-cooled condenser shall be a low profile, slow speed and direct drive propeller fan type. The condenser shall be constructed of aluminum and contain a copper tube and aluminum fin coil. The air discharge shall be vertical to minimize the effects of wind blowing through the coil at low ambient temperatures. The condenser shall have fan speed control with transducer to modulate the speed of the first condenser fan and provide positive start-up and operation at ambient temperatures down to -20ºF (-29ºC). Additional condenser fan motors are to be controlled by ambient thermostats. All controls including the fan speed control shall be factory

mounted in the air cooled condenser in an integral factory wired and tested control panel. The air cooled condenser shall be manufactured by the manufacturer of the indoor unit

E. Filter: 50-mm- (2-inch-) thick, disposable, glass-fiber media.

1. MERV: 14 according to ASHRAE 52.2.

F. Electrode Steam Humidifier: Self-contained, microprocessor-controlled unit with disposable, polypropylene-plastic cylinders, and having field-adjustable steel electrodes and stainless-steel steam dispersion tube.

1. Plumbing Components and Valve Bodies: Plastic, linked by flexible rubber hosing, with water fill with air gap and solenoid valve incorporating built-in strainer, pressure-reducing and flow-regulating orifice, and drain with integral air gap.

a. Makeup Water: City water.

2. Control: Fully modulating to provide gradual modulation from zero to 100 percent capacity with field-adjustable maximum capacity; with high-water probe.
3. Drain Cycle: Field-adjustable drain duration and drain interval.

G. Disconnect Switch: Non-automatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

1. Single point power connection.

H. Control System:

1. Microprocessor remote-mounted panel.

a. Digital Display: LCD screen with menu and push buttons for setpoint adjustments and diagnostics.

2. Fan speed controller.
3. Control transformer with circuit breaker.
4. Solid-state temperature and humidity control modules with unit -mounted sensor(s).
5. Humidifier variable output control.
6. Time-delay relay.
7. Smoke sensor.
8. Filter clog.
9. Alarm.
10. High-temperature thermostat.
11. Condensate pan full.
12. Humidifier overcurrent.
13. Humidifier fault.
14. Humidifier cylinder end of life.
15. Sequential load activation and self-diagnostics.
16. BAS Interface: BACnet for monitoring, alarms, and setpoint adjustment.

2.4 FAN MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load does not require motor to operate in service factor range above 1.0.

C. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

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 hydronic piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where computer-room air conditioners will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Layout and install computer-room air conditioners and suspension system coordinated with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Install computer-room air conditioners level and plumb, maintaining manufacturer's recommended clearances.

C. Computer-Room Air-Conditioner Mounting: Install using vibration isolators. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to computer-room air conditioners, allow space for service and maintenance.

C. Water and Drainage Connections: Comply with applicable requirements in Division 22 Section "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

D. Install remote mounted sensors and controllers and interconnect with associated CRAC.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing computer-room air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
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.

B. Computer-room air conditioners will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

D. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: 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.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air conditioners.

END OF SECTION 238123

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Connectors, splices.

1.3 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For each conductor and cable indicating lead content.
2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
3. Product Data: For solvents and adhesives, indicating VOC content.

C. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cerro Wire LLC.
2. General Cable Technologies Corporation.
3. Service Wire Co.
4. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable Technologies Corporation.
2. Service Wire Co.
3. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.

H. Armor: Steel, interlocked.

I. Jacket: PVC applied over armor.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.
2. Hubbell Power Systems, Inc.
3. Ideal Industries, Inc.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Thomas & Betts Corporation.

C. Jacketed Cable Connectors: For steel jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

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.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and under 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 WIRING FOR LIGHTING FIXTURES AND RECEPTACLES

A. Type MC cable shall be allowed for connections within a room from a junction box above the ceiling to the lighting fixtures.

B. Branch circuit home runs shall be in EMT from panelboard to junction box above ceiling.

C. Type MC cable shall be allowed from a junction box above the ceiling within a room of the receptacles in the same room.

D. Type MC cable shall not be allowed to cross one room to another room whether the wall between two rooms goes up to slab or not. If the rooms are identified as two separate rooms, Type MC cable shall not be used between the two rooms.

E. Type MC cable shall not be used between two receptacles when they are in two separate rooms, on the same wall.

3.5 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.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.6 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.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 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."

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    b. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.

    c. Inspect compression-applied connectors for correct cable match and indentation.
    d. Inspect for correct identification.
    e. Inspect cable jacket and condition.
    f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    g. Continuity test on each conductor and cable.
    h. Uniform resistance of parallel conductors.

3. Initial Infrared Scanning: After Substantial Completion, but before 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. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

D. Cables will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports 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.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.

1.3 ACTION SUBMITTALS

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

B. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Product Data: For each conductor and cable indicating lead content.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Grounding arrangements and connections for separately derived systems.
2. Ground rods.

B. Qualification Data: For testing agency and testing agency's field supervisor.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Hubbell Incorporated, Construction and Energy.
2. ERICO ; nVent.
3. ILSCO.
4. Blackburn; Thomas & Betts.
5. Crouse Hinds; Eaton.

2.2 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 UL 467 for grounding and bonding materials and equipment.

2.3 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.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.

Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 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. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamps: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

I. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.

J. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

K. Water Pipe Clamps:

1. Mechanical type, two pieces with zinc-plated bolts.

a. Material: Tin-plated aluminum.

2. U-bolt type with malleable-iron clamp and copper ground connector.

2.5 GROUNDING ELECTRODES

A. Ground Rods: One piece type, copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

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 tinned-copper conductor, No. 4/0 AWG minimum.

1. Bury at least 30 inches (750 mm) below grade.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

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 all feeders and branch circuits.

B. 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. Metal-clad cable runs.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. 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: 1 ohm(s).

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Slotted support systems, hardware, and accessories.

2. Include rated capacities and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-(10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; Atkore International.
b. B-Line, Eaton Electrical Sector.
c. Caddy; nVent.
d. ABB, Electrification Products Division.
e. Unistrut; Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored 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 made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. 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; Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.

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 where used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Hilti, Inc.
        2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) B-Line; Eaton, Electrical Sector.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A235.
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 the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101, “Standard for Installing Steel Conduits.”

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT, IMC, and RMC may be supported by openings through structure members, according to 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: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
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.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for 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. Submit welding certificates.

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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Metal wireways and auxiliary gutters.
3. Surface raceways.
4. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFC Cable Systems; a part of Atkore International.
b. Allied Tube & Conduit; a part of Atkore International.
c. Republic Conduit.
d. Southwire Company.

e. Western Tube and Conduit Corporation.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. EMT: Comply with ANSI C80.3 and UL 797.
5. FMC: Comply with UL 1; zinc-coated steel.
6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
7. FMT: Flexible metallic tubing, plenum rated/liquid tight.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFC Cable Systems; a part of Atkore International.
b. Allied Tube & Conduit; a part of Atkore International.
c. Republic Conduit.
d. Southwire Company.
e. Western Tube and Conduit Corporation.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:

a. Material: Steel.
b. Type: Set Screw.

7. Expansion Fittings: Steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

C. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. MonoSystems, Inc.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.3 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

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. Wiremold/Legrand (AL3300 series raceway).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. MonoSystems, Inc.
d. Panduit Corp.
e. Union Products International, Inc.

2. Devices and Wiring:

a. Receptacles: As indicated on drawings.
b. Receptacle Spacing: Locate as necessary to serve security racks.
c. Wiring: As indicated on drawings.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.
2. Eaton business (Crouse-Hinds).
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a brand of Pentair Equipment Protection.
7. Hubbell Incorporated.
8. Wiremold: Legrand North America, LLC.
9. Milbank Manufacturing Co.
10. MonoSystems, Inc.
11. Oldcastle Enclosure Solutions.

12. O-Z/Gedney; a brand of Emerson Industrial Automation.
13. Pass & Seymour; Legrand North America, LLC.
14. RACO; Hubbell.
15. Spring City Electrical Manufacturing Company.
16. ABB (Electrification Division).
17. Topaz Lighting & Electric.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. 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.

F. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

J. Gangable boxes are allowed.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.
b. NewBasis.
c. Oldcastle Enclosure Solutions.
d. Oldcastle Precast, Inc.

2. Standard: Comply with SCTE 77.

3. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

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 Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment not in the environmental airstream): LFMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.
5. Connection to Motor-Driven Equipment in the environmental airstream: FMT or FMC.

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. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. 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.
8. Connections to Motor-Driven Equipment in the environmental airstream: FMT or FMC

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 Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. 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.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. 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.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm)of enclosures to which attached.

L. Raceways shall not be embedded in slabs:

1. No conduits shall be run in concrete slab unless specifically indicated on the electrical drawings.
2. Aluminum conduit is not permitted to be embedded in concrete slabs.
3. When conduits are allowed embedded in concrete slabs the following apply:

    a. Conduits in concrete slabs must be spaced such that the distance between conduits, centerline to centerline, is a minimum of three times the outside diameter of the largest conduit.
    b. No conduit may be placed in the concrete slab which has an outside diameter larger than one-third the total slab thickness.
    c. Conduit shall be placed in the middle one-third of the slab thickness.
    d. Conduits which cross one another in the concrete slab shall not consume a total space at the point of crossover that is greater than one-third the total slab thickness.

e. Conduit embedded in slabs shall not pass through cages.

4. When conduit is to be placed in the slab, the Contractor must advise the Structural Engineer of the number of conduits to be placed and indicate proposed method of installation for the conduits. No conduit shall be placed without the Structural Engineer's approval.

M. Stub-ups to Above Accessible Ceilings:

1. Use EMT or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. 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.

O. 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 (35mm) 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.

P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

R. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

S. 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.

T. 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.

U. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

V. 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. Conduit extending from interior to exterior of building.
4. Where otherwise required by NFPA 70.

W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

X. 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). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 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 deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi recessed 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.

Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

BB. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

CC. Locate boxes so that cover or plate will not span different building finishes.

DD. 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.

EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

FF. Set metal floor boxes level and flush with finished floor surface.

GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, 30 inches (762 mm) below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 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 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve seal systems.
4. Grout.
5. Pourable sealants.
6. Foam sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Wall Sleeves, Steel:

1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Sheet Metal Sleeves, Galvanized Steel, Round:

1. Description: Galvanized-steel sheet; thickness not less than 0.0239-inch (0.6-mm); round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Description:

a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness must be 0.052 inch (1.3 mm).
2) For sleeve cross-section rectangle perimeter not less than 50 inches (1270 mm) or with one or more sides larger than 16 inches (400 mm), thickness must be 0.138 inch (3.5 mm).

2.3 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.5 POURABLE SEALANTS

A. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Sustainability Criteria:

1. Sealant shall have a VOC content of 100 g/L or less.

2.6 FOAM SEALANTS

A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

B. Sustainability Criteria:

1. Sealant shall have a VOC content of 100 g/L or less.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS

A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

B. Comply with NFPA 70, “National Electrical Code.”

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (49 deg C), ambient; 180 deg F (82 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 480/277-V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

4. Color for Neutral: White or gray.
5. Color for Equipment Grounds: Green.
6. Colors for Isolated Grounds: Green with two or more yellow stripes.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, polyester flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:

a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and is 12 inches (300 mm) wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".

3. Tag: Type I:

a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches (75 mm).
c. Thickness: 4 mils (0.1 mm).
d. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
e. Tensile according to ASTM D 882: 30 lbf (133.4 N) and 2500 psi (17.2 MPa).

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch (0.38 mm) thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.

C. Write-on Tags:

1. Polyester Tags: 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel 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).

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, 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).

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:

a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick).
b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
c. Engraved legend with black letters on white face.
d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.

e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. 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.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

M. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. 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.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

V. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches (305 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.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

W. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

X. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

Y. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

Z. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

AA. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. 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 sign; where two lines of text are required, use labels 2 inches (50 mm) high.

BB. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. 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 sign; where two lines of text are required, use labels 2 inches (50 mm) high.

CC. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification 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.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, and handholes, use vinyl wraparound labels to identify the phase.

1. Locate identification 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.

F. 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.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: Marker tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

K. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Apply to exterior of door, cover, or other access.
2. 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.

N. Arc Flash Warning Labeling: Self-adhesive labels.

O. Operating Instruction Signs: Baked-enamel warning signs.

P. Emergency Operating Instruction Signs: Baked-enamel warning 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.

Q. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Provide updated typed panelboard directories for each existing panelboard where changes were made. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
e. Emergency system boxes and enclosures.
f. Enclosed switches.
g. Enclosed circuit breakers.
h. Enclosed controllers.
i. Variable-speed controllers.
j. Contactors.
k. Remote-controlled switches, dimmer modules, and control devices.
l. Monitoring and control equipment.

END OF SECTION 260553

SECTION 260573.13 - SHORT-CIRCUIT STUDIES

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 a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.

B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

G. SCCR: Short-circuit current rating.

H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data:

1. For computer software program to be used for studies.

2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

    a. Short-circuit study input data, including completed computer program input data sheets.
    b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

        1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
        2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
2. The following are from the Short-Circuit Study Report:

    a. Final one-line diagram.
    b. Final Short-Circuit Study Report.
    c. Short-circuit study data files.
    d. Power system data.

1.7 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.

F. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EDSA Micro Corporation.
2. ESA Inc.
3. Operation Technology, Inc.
4. Power Analytics, Corporation.
5. SKM System Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

1. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by the study.

D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:

1. One-line diagram of system being studied.
2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. Calculated asymmetrical fault currents:

1) Based on fault-point X/R ratio.
2) Based on calculated symmetrical value multiplied by 1.6.
3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.

1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.

B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility available fault current at the service.
3. Power sources and ties.

4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
6. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
8. Motor horsepower and NEMA MG 1 code letter designation.
9. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
10. Derating factors.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.
2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

I. Include in the report identification of any protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

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 a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

G. SCCR: Short-circuit current rating.

H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

E. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations,

licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

G. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EDSA Micro Corporation.
2. ESA Inc.
3. Operation Technology, Inc.
4. Power Analytics, Corporation.
5. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

F. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

G. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

H. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch (76-by-127-mm) self-adhesive equipment label for each work location included in the analysis.

B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.

a. Arc-flash boundary.
b. Restricted approach boundary.
c. Limited approach boundary.

4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination studies prior to starting the Arc-Flash Hazard Analysis.

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.

D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.

F. Calculate the limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors shall not be considered beyond three to five cycles.

2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.
2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance or available short circuit current at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.

11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.4 LABELING

A. Apply one arc-flash label on the front cover of each section of the equipment for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below shall have an arc-flash label applied to it:

1. Low-voltage switchboard.
2. Switchgear.
3. Low voltage transformers.
4. Panelboard and safety switch over 250 V.
5. Applicable panelboard and safety switch under 250 V.
6. Control panel.

C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.

1. Indicate arc-flash energy.
2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION 260573.19

SECTION 260923 - LIGHTING CONTROL DEVICES

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. Indoor occupancy and vacancy sensors (not associated with spaces covered under Section 260933 “Lighting Control System”.
2. Emergency shunt relay.
3. Conductors and cables.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings:

1. Show installation details for the following:

a. Occupancy sensors.
b. Vacancy sensors.

2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bryant Electric.
2. Cooper Industries, Inc.
3. Douglas Lighting Controls.
4. Hubbell Control Solutions; Hubbell Inc. Lighting.
5. Intermatic, Inc.
6. Leviton Manufacturing Co., Inc.
7. Lithonia Lighting; Acuity Brands Lighting, Inc.
8. Lutron Electronics Co., Inc.
9. NSi Industries LLC.
10. RAB Lighting.
11. Sensor Switch, Inc.
12. Signify North America Corporation (formerly Philips Lighting).

B. General Requirements for Sensors:

1. Wall-mounted, solid-state indoor occupancy sensors.
2. Dual technology.
3. Integrated power pack.
4. Hardwired connection to switch and BAS.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:

    a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source.
10. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard device box or outlet box.
    b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

C. Dual-Technology Type: Wall mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted 48 inches (1200 mm) above finished floor.

2.2 EMERGENCY SHUNT RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lighting Control and Design.
2. WattStopper; a Legrand® Group brand.
3. LVS, Inc.

B. Description: NC, electrically held relay, arranged for wiring in parallel with manual switching contacts; complying with UL 924.

1. Coil Rating: 120 or 277 V.

2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SENSORS

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 INSTALLATION OF CONTACTORS

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 INSTALLATION OF WIRING

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

C. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's written instructions.

D. Size conductors in accordance with lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems.

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.8 DEMONSTRATION

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

END OF SECTION 260923

SECTION 260933 - LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections:

1. Section 260923 “Lighting Control Devices”.
2. Section 265119 “LED Interior Lighting”.

1.2 SUMMARY

A. Section includes:

1. The floor plans and schematics on drawings represent control intent only, and do not indicate every piece of control hardware and software required to meet the control intent. Three manufacturers are listed herein. Each manufacturer may utilize a different approach to meet the design intent. As such, the contractor must submit complete shop drawings, including schematic diagrams and bill of materials including all hardware and software components for a complete functioning system that meets the design intent.

1.3 DEFINITIONS

A. BACnet: A networking communication protocol that complies with ASHRAE 135.

B. BAS: Building automation system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, network materials, switches and plates, and conductors and cables.

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

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
5. Sequence of Operations: Describe how each area operates and how any building wide functionality is described.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

B. Field quality-control reports.

C. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Make ordering of new equipment for expansions, replacements, and spare parts available to end-user, qualified dealer or installer. Make new replacement parts available for minimum 10 years from date of purchase.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control equipment through one source from a single manufacturer.

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

C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with protocol described in IEC 60929, Annex E, for DALI lighting control devices, wiring, and computer hardware and software.

E. Comply with NFPA 70, “National Electrical Code.”

1.9 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of lighting control functions.
2. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.
3. Coordinate lighting controls with LED drivers for each LED lighting fixture type.

1.10 WARRANTY

A. Provide manufacturer's full 5 year warranty covering 100 percent parts and 100 percent labor from the date of system startup completion.

1. Support and Maintenance Plan: includes 100 percent parts and labor coverage, 24 hours per day, 7 days per week telephone technical support, and can be renewed annually.

B. Provide a 5-year parts and labor warranty for front end hardware and software.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wattstopper / Legrand.
2. Eaton Lighting Systems Room Controller Network.
3. Lutron Electronics Co., Inc.

2.2 SYSTEM REQUIREMENTS

A. Provide lighting controls on a per-room basis. System requirements shall include:

1. Lighting Controls: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F) and 90 percent non-condensing relative humidity.
2. Designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

2.3 CEILING MOUNTED OCCUPANCY PERFORMANCE REQUIREMENTS

A. Sensing mechanism:

1. Dual technology:

a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.

b. Utilize an operating frequency of 32 kHz or 40 kHz that shall be crystal controlled to operate within plus or minus 0.005% tolerance.
c. Incorporate Doppler shift ultrasonic and passive infrared motion detection technologies. Products that react to noise or ambient sound shall not be considered.

B. Power Failure Memory:

1. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.

C. Designed and tested to withstand discharges of 15,000 volts per IEC 801-2 without impairment of performance.

D. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards.

E. Sensor shall have time delays from 10 to 30 min.

F. Sensors shall automatically adjust time delay and sensitivity settings.

G. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

2.4 CEILING MOUNTED SENSORS

A. Provide all necessary mounting hardware and instructions.

B. Sensors shall be Class 2 devices.

C. Connect to Room Controller via Click & Go cable to eliminate wiring errors.

1. Room Controller accessory is used to allow any standard occupancy/vacancy sensor to utilize Click & Go cable connections.
2. Two RJ45 connection ports for connection to Room Controller.
3. Occupancy Sensor and Daylight sensor shall be capable of a daisy chain connection to the Room Controller.

D. Device calibration and features:

1. Sensitivity – 0-100% in 10% increments.
2. Time delay – 1-30, self-adjusts to 10 min based on room occupancy.
3. Test mode – Fifteen second time delay.
4. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
5. Walk-through mode.
6. Ultrasonic and Dual Technology Sensors utilize two independent sensor detection circuits simultaneously to ensure optimum performance, regardless of location or proximity to walls and structures.
7. Ultrasonic and Dual Technology Sensors utilize Variable Drive Circuitry (VDC) in cases of over saturation from misapplication, which automatically adjusts the volumetric output

without reducing detection capability. Systems that reduce detection coverage area shall not be acceptable.

8. Automatically and continually self-adjust ultrasonic frequency to ignore specific frequency, continuous noise from airflow to prevent detuning which can lead to inadvertent lights out. Sensors that require detuning shall not be acceptable.
9. All load parameters including Automatic On/Manual On, blink warning and daylight enable/disable when daylight sensors are pre-defined with the Room Controller local network.

E. Device Status LEDs including:

1. PIR Detection
2. Ultrasonic detection

F. Occupancy sensors are pre-defined to specific loads within the room without wiring or special tools for maximum energy savings.

G. Manual override of controlled loads.

H. Multiple occupancy sensors may be installed in a room by simply daisy-chaining them together to the Room Controller via Click & Go cable. No additional configuration will be required

I. Sensors shall be RoHS compliant.

2.5 ROOM CONTROLLER ZONE WALLSTATIONS

A. Low voltage momentary pushbutton switches in 4 button configuration; available in white; compatible with wall plates with decorator opening. Wallstations shall include the following features:

1. Removable buttons for field replacement with engraved buttons ENGRV-*BTNS-*. Button replacement may be completed without removing the switch from the wall.
2. Intuitive button labeling to match application and load controls.
3. Pre-defined digital button configurations. Each wallstation is shipped with pre-defined digital button configurations which are automatically sensed by the connected Room Controller and mapped to specific load controls for immediate out of the box functionality.

B. Two RJ-45 ports for connection to the Room Controller local network.

C. Multiple digital wallstations may be installed in a room by simply connecting them to the Room Controller local network. No additional configuration will be required to achieve multi-way switching.

D. Room Controller digital wallstations are delivered with pre-defined functions including, raise, lower, A/V Mode, Quiet Time, manual and scene control. No additional configuration is required to provide a fully functional system.

E. Optional custom labeling is available for application or location specific wallstation button labels.

2.6 ROOM CONTROLLERS

A. Room Controllers are fully functional out-of-the-box to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will include line voltage wiring space and will not require additional electrical junction boxes. The control units will include the following features:

B. Fully functional room configuration to the most energy-efficient sequence of operation based upon the connected devices in the room.

C. Simple replacement – Using the automatic configuration capabilities, a Room Controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.

D. Quick installation features including:

1. Included line voltage space to simplify wiring and eliminate the need for separate junction boxes.
2. Included emergency voltage space to simplify wiring of emergency luminaire connections.
3. Breakouts or knockouts for direct conduit connection.
4. Line and low voltage sections include conduit connection points. Systems that require special accessories for direct conduit connections may not comply with local building codes and shall not be acceptable.
5. Quick low voltage connections using standard RJ45 QuickConnect cable.
6. Dual voltage (120/277 VAC, 60 Hz).
7. Zero cross circuitry for each load.
8. Three relay configuration.
9. Efficient 150 mA switching power supply.
10. Six RJ45 Click & Go local network ports.
11. All models shall be available in either a plastic or metal enclosure for simplified installation in appropriate spaces
12. All models support local network connections of wallstations, occupancy-based controls and receptacle controls.

E. On/Off/Dimming Room Controllers shall include:

1. Metal enclosure.
2. Three relay, switching zone configuration.

    a. All models support local network connections of wallstations, occupancy-based controls and receptacle controls.

3. Three relay, three 0-10V dimming zone configuration.

    a. All models support local network connections of wallstations, occupancy-based controls and receptacle controls.
    b. Up to three 0-10V analog outputs per relay for control of compatible ballasts and LED drivers.

4. Three relay, three 0-10V dimming zone configuration with one emergency UL 924 relay.

a. All models support local network connections of wallstations, occupancy-based controls and receptacle controls.
b. Up to three 0-10V analog outputs per relay for control of compatible ballasts and LED drivers.

5. Three relay, three 0-10V dimming zone configuration for patient rooms.

a. All models support local network connections of wallstations, occupancy-based controls and receptacle controls.
b. Up to three 0-10V analog outputs per relay for control of compatible ballasts and LED drivers.

2.7 EMERGENCY LIGHTING

A. Room Controller with emergency relay – The Room Controller is a UL 924 listed device that monitors normal power circuit to the Room Controller. The Room Controller has a dedicated UL 924 output which includes emergency power line in and emergency power load out connections. The UL 924 relay will track with output 1 (Yellow) during normal power operations. Upon loss of normal power the UL 924 output will force the emergency lighting On and full bright (if dimming) until normal power is restored. Features include:

1. 120/277VAC, 50/60 Hz, 3 amp rating.
2. Laddarless testing: Push the "All Off" button on any wallstation four times, will turn off normal lighting and force UL 924 emergency output On and full bright.
3. Auxiliary input for remote Alert Mode (All On, and full bright).

B. Emergency Power Control – A UL 924 listed device installs down line of an output that monitors a switched or dimmed circuit providing normal lighting to an area. The unit provides normal ON/OFF or 0-10V dimming control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:

1. 120/277 volts, 50/60 Hz., 20 amp ballast rating.
2. Push to test button.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Comply with NECA 1, "Standard Practice for Good Workmanship in Electrical Construction."

B. Wiring Method: Install wiring in raceways. Minimum conduit size shall be 3/4 inch.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

E. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

F. Install equipment in accordance with manufacturer’s installation instructions.

G. Provide complete installation of system in accordance with Contract Documents.

H. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

I. Define each dimmer's/relay’s load type, assign each load to a zone, and set control functions.

J. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.

K. Identify components and power and control wiring according to 260553 Section "Identification for Electrical Systems."

3.2 SERVICE AND SUPPORT

A. Startup and Programming

1. Provide factory certified field service engineer to make minimum of three site visits to ensure proper system installation and operation under following parameters

a. Qualifications for factory certified field service engineer:

1) Minimum experience of 2 years training in the electrical/electronic field.
2) Certified by the equipment manufacturer on the system installed.

b. Make first visit prior to installation of wiring. Review:

1) Low voltage wiring requirements.
2) Separation of power and low voltage/data wiring.
3) Wire labeling.
4) Lighting Management Panel locations and installations.
5) Control locations.
6) Computer jack locations.
7) Load circuit wiring.
8) Network wiring requirements.
9) Connections to other equipment and other Lutron equipment.
10) Installer responsibilities.

c. Make second visit upon completion of installation of Lighting Control System:

1) Verify connection of power wiring and load circuits.
2) Verify connection and location of controls.
3) Energize Lighting Management Panels and download system data program.
4) Address devices.
5) Check dimming panel load types and currents and supervise removal of by-pass jumpers.

6) Verify system operation control by control.
7) Verify proper operation of manufacturers interfacing equipment.
8) Verify proper operation of manufacturers supplied PC and installed programs.
9) Configure initial groupings of ballast for wall controls, daylight sensors and occupant sensors.
10) Initial calibration of sensors.
11) Obtain sign-off on system functions.

d. Make third visit to demonstrate and educate Owner's representative on system capabilities, operation and maintenance.

2. Startup

a. System software configuration

1) Naming and association of areas and lighting zones.
2) Coordinate interface with Building Automation System (BAS), including but not limited to scheduling, zone setup, demand limiting signals.

b. After Hours Start-up

1) Provide factory certified Field Service Engineer to perform manufacturer's start-up procedures outside normal working hours (Monday through Friday, 7a.m. to 6 p.m.)

3. Documentation

a. After each visit and completion of programming, provide a detailed written report of all project-specific programming settings.

B. Training of customer representatives for system software.

1. Configuration Software used to make system programming and configuration changes
2. Control and Monitor

C. Tech Support

1. Provide factory direct technical support hotline 24 hours per day, 7 days per week.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. 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.

D. Tests and Inspections:

1. Test for circuit continuity.
2. Verify that the control module features are operational.
3. Check operation of local override controls.
4. Test system diagnostics by simulating improper operation of several components selected by Architect.

E. Lighting controls will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.4 ADJUSTING

A. Occupancy Adjustments: 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 DEMONSTRATION

A. On-site Walkthrough

1. Manufacturer to provide a factory certified Field Service Engineer to demonstrate system functionality to the Commissioning Agent.

B. Training Visit

1. Manufacturer to provide 1-day additional on-site system training
2. Representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls, shade controls, and software training for PC-based control system. See Division 01 Section 017900 "Demonstration and Training”.

C. Training of the owner’s operation and maintenance personnel is required in cooperation with the Commissioning Authority. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Commissioning Authority after submission and approval of formal training plans.

1. Refer to Section 017900 for contractor training requirements.

END OF SECTION 26 09 33

SECTION 26 2250 - LOW-VOLTAGE (HARMONIC MITIGATING) TRANSFORMERS

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 types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Low-voltage (harmonic mitigating) transformers

1.3 DEFINITIONS

A. HMT: Harmonic mitigating transformers.

B. Linear Load: A load (i.e., a motor, incandescent lamp, resistor) that does not influence the shape of the original sinusoidal current waveform but may change the relative timing (phase angle) between the sinusoidal voltage and current waveform.

C. Nonlinear Load: A load (i.e. rectifier, arc, motor drive, switch-mode power supply, fluorescent lamp) that influences the shape of the current waveform resulting in a condition in which total harmonic distortion of current (THDI) is greater than total harmonic distortion of voltage (THDV). Because the current supplying a nonlinear load is interrupted by a switching action, the current contains frequency components (harmonics) that are multiples of the fundamental frequency.

D. Total Harmonic Distortion of Current (THDi): A measure of the harmonic current distortion present in a system or sub-system defined as the ratio of the sum of all harmonic current frequency components to the fundamental current frequency component.

E. Total Harmonic Distortion of Voltage (THDv): A measure of the harmonic voltage distortion present in a system or sub-system defined as the ratio of the sum of all harmonic voltage frequency components to the fundamental voltage frequency component.

1.4 ACTION SUBMITTALS

A. Product Data: Submit the following information for review and approval by the engineer of record prior to delivery and installation of each transformer that is to be supplied for this project.

1. Nameplate kVA rating.
2. Nominal Voltage rating, primary and secondary.
3. Winding configuration, primary and secondary.
4. Core and coil materials.
5. Taps, quantity and configuration.

6. Dimensions.
7. Weight.
8. Accessories.
9. Performance Characteristics:

    a. Frequency.
    b. Impedance.
    c. Insulation class.
    d. Temperature rise.
    e. Sound level.
    f. BIL rating.
    g. Inrush data.
    h. Accessories.
    i. Loss and efficiency data.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

    1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

    1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

        a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

    2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
    3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control test reports.

C. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Transformer manufacturers proposing to submit a bid for harmonic mitigating transformers shall have a minimum of twenty years' experience in the design and manufacture of harmonic mitigating transformers. Manufacturing experience in the design and manufacture of general purpose transformers does not qualify.
2. Manufacturer shall be ISO 9001 certified.

B. Source Limitations: Obtain each transformer type through one source from a single manufacturer. Pricing for transformers must be provided separate from other distribution system equipment and must be clearly listed on the bid form based on manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.8 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer warrants that the product(s) delivered conforms to the specifications and is free from defects in material and workmanship for the Warranty Period(s) indicated below, pro-rated from the date of Substantial Completion, provided that the product(s) have not been misused, abused, altered, neglected, improperly installed or damaged.

B. Warranty Period: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Terms and Conditions

a. Harmonic Mitigating – High Efficiency Transformers: Twenty (20) years pro-rated, with standard limited liability clauses provided that the manufacturer participates in and approves of the product application indicated on the Drawings.

C. Limit of Liability:

1. Manufacturer’s overall liability is limited to the cost of the product or defective part.

PART 2 - PRODUCTS

2.1 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores:

1. Three-phase, common core construction with one leg per phase.
2. Grain-oriented, non-aging silicon steel.
3. Anti-vibration pads shall be installed between the core and the enclosure.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed type.
2. Coil Material: Copper.

D. Voltage Class: 1.2 kV.

E. BIL Rating: 10 kV

F. Magnetic Field: 0.1 Gauss at a maximum of 18 inches.

G. Losses and Efficiency:

1. Linear load losses and efficiency:

a. Linear losses and efficiency shall be determined in accordance with U.S. Department of Energy (DOE) Code of Federal Regulations (CFR) requirements as defined in Energy, 10 CFR. §431, Subpart K, Appendix A (2015) using the "Open Circuit and Short Circuit Test Method". Manufacturers shall provide proof of compliance Type Tests for each transformer type and kVA rating. Type Tests are required with each submission.
b. Linear loss curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating. Linear losses at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent and 100 percent of full load shall be easily identified on each transformer loss curve AND shall be identified separately in table or other form to the nearest thousandth of a kilowatt (kW).
c. Linear efficiency curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating. Linear efficiency ratings at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent, and 100 percent of full load shall be easily identified on each transformer efficiency curve and shall be identified separately in table or other form to the nearest one hundredth of one percent.

2. Nonlinear load losses and efficiency:

a. Currently, there are no recognized standards for “measuring” transformer losses and determining transformer efficiencies under nonlinear load conditions. Therefore, nonlinear losses and efficiencies must be calculated in accordance with IEEE Std. C57.110-2004, “IEEE Recommended Practice for Establishing

Transformer Capability When Supplying Non-sinusoidal Load Currents". Manufacturers shall provide proof of compliance calculations for each transformer type and kVA rating. Calculations are required with each submission.

1) IEEE Std. C57.110-2004 enables any transformer manufacturer to utilize the known linear losses and efficiencies of their transformers, which must be obtained using the "Open Circuit and Short Circuit Test Method", defined in Energy, 10 CFR. §431, Subpart K, Appendix A (2015), to calculate the nonlinear losses and efficiencies of those same transformers under any "specific" nonlinear load condition. For the purposes of this specification, a "specific" nonlinear load condition shall be characterized by the transformer's load level (as a percentage of nameplate kVA rating), load K-Factor and FHL (Harmonic Loss Factor), load harmonic spectrum including harmonic magnitudes and load %THDi.
2) Nonlinear load testing programs that incorporate the use of capacitors, inductors, resistors, rectifiers, switch-mode power supplies or other electronic loads in an effort to simulate perceived, real world nonlinear load conditions in a controlled manufacturing environment are not acceptable since (i.) these testing programs are unique to each manufacturer, (ii.) non-duplicable due to source impedance variations at each manufacturer's facility and (iii.) highly inaccurate due to significant and unavoidable loss measurement and calculated efficiency errors that exist when using the "Power-In - Power-Out Method". As documented by ANSI/IEEE, when using the "Power-In - Power-Out Method" to determine input and output power characteristics, the loss measurement error may exceed plus or minus 51.6 percent and calculated efficiency error may exceed plus or minus 1.34 percent, even when using synchronized, revenue class CTs, VTs and Wattmeters.
3) Additionally, nonlinear load testing programs receive no professional, technical or governmental oversight since there are no recognized nonlinear testing standards that can be used for reference. This inevitably gives manufacturers the liberty to develop their own unique testing protocols which cannot be compared and evaluated equally against other manufacturers' who may have completely different testing protocols.

b. Nonlinear loss curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating based on a "specific" nonlinear load condition characterized by having a 35% of nameplate kVA load, UL 1561 load K-Factor of K13, load harmonic spectrum equal to [1st-1.0, 3rd-0.150, 5th-0.320, 7th-0.250, 9th-0.080, 11th-0.150, 13th-0.125, 15th-0.040] and %THDi of 48.32%. Nonlinear losses at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent and 100 percent of full load shall be easily identified on each transformer loss curve AND shall be identified separately in table or other form to the nearest thousandth of a kilowatt (kW).
c. Nonlinear efficiency curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating based on the same "specific" nonlinear load condition used to calculate nonlinear losses (refer paragraph b. above). Nonlinear efficiency ratings at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent and 100 percent of full load shall be easily identified on each

transformer efficiency curve AND shall be identified separately in table or other form to the nearest one hundredth of one percent.

2.2 DISTRIBUTION TRANSFORMERS

A. Harmonic Mitigating, Isolation Transformers for Medium K-Factor Loads (K-Factor Greater Than 4.0 and Less Than or Equal to 13.0 and THDi Greater Than 20 percent and Less Than or Equal to 40 Percent), with losses equal to or less than required by Energy, CFR 10 §431.196(a)(2) (2015) or comparable product:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Power Quality International LLC.
2. Digital Signal Power Manufacturing.
3. Siemens Energy.
4. Square D; a brand of Schneider Electric.
5. Harmonic mitigating transformers shall be fabricated according to the following:

a. CSA C9-M.
b. CSA22.2 No. 47.
c. CSA C802.2.
d. UL-1561
e. ANSI C57.110
f. NEMA ST-20

6. Description:

a. Single input, single output.
b. Energy Efficiency: Low voltage, dry-type, harmonic mitigating, distribution transformers shall be high efficiency (PQI ZS efficiency option or equivalent) and therefore must meet or exceed all of the following loss and energy efficiency requirements:

1) High Efficiency (ZS):

a) Losses less than or equal to Energy, CFR 10 §431.196(a)(2) (2015) under 35 percent linear load conditions.
b) Maximum losses and minimum efficiency under linear load conditions per Table 1 - ZS Linear, High Efficiency.

Table 1 - ZS Linear, High Efficiency
Max and Min Values for Losses and Efficiency for "High Efficiency" Transformers
Meeting Energy, CFR 10 §431.196(a)(2) (2015) Efficiency Levels Under Linear Loading

kVA	No Load		35% Load		Full Load	
	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)
15	0.0566	0.0000	0.1132	0.9789	0.5185	0.9666

Table 1 - ZS Linear, High Efficiency
Max and Min Values for Losses and Efficiency for "High Efficiency" Transformers
Meeting Energy, CFR 10 §431.196(a)(2) (2015) Efficiency Levels Under Linear Loading

kVA	No Load		35% Load		Full Load	
	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)
30	0.0946	0.0000	0.1892	0.9823	0.8668	0.9719
45	0.1280	0.0000	0.2561	0.9840	1.1733	0.9746
75	0.1864	0.0000	0.3727	0.9860	1.7077	0.9777
112.5	0.2512	0.0000	0.5025	0.9874	2.3021	0.9799
150	0.3027	0.0000	0.6054	0.9886	2.7737	0.9818
225	0.4218	0.0000	0.8437	0.9894	3.8655	0.9831
300	0.5196	0.0000	1.0392	0.9902	4.7612	0.9844
500	0.7590	0.0000	1.5181	0.9914	6.9552	0.9863

c) Nonlinear losses and efficiency shall be based on the following:

i. UL 1561 load K-Factor: K13
ii. Harmonic Spectrum: 1st (1.0), 3rd (0.150), 5th (0.320), 7th (0.250), 9th (0.080), 11th (0.150), 13th (0.125), 15th (0.040).
iii. THDi: 48.32%

d) Maximum losses and minimum efficiency per Table 2 - ZS Nonlinear, High Efficiency, based on the nonlinear load conditions stated in paragraphs c) i., ii. and iii. above.

Table 2 - ZS Nonlinear, High Efficiency
Max and Min Values for Losses and Efficiency for High Efficiency Transformers
Under K13 Nonlinear Loading [THDi: 48.32% , Harmonic Spectrum: 1st (1.0), 3rd (0.150), 5th (0.320), 7th (0.250), 9th (0.080), 11th (0.150), 13th (0.125), 15th (0.040)]

kVA	No Load		35% Load		Full Load	
	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)
15	0.0566	0.0000	0.1253	0.9767	0.6954	0.9557
30	0.0946	0.0000	0.2149	0.9799	1.2400	0.9603
45	0.1280	0.0000	0.2968	0.9815	1.7656	0.9622
75	0.1864	0.0000	0.4346	0.9837	2.6076	0.9664
112.5	0.2512	0.0000	0.5965	0.9851	3.6692	0.9684
150	0.3027	0.0000	0.7229	0.9864	4.4828	0.9710
225	0.4218	0.0000	1.0153	0.9873	6.3621	0.9725

Table 2 - ZS Nonlinear, High Efficiency
Max and Min Values for Losses and Efficiency for High Efficiency Transformers
Under K13 Nonlinear Loading [THDi: 48.32% , Harmonic Spectrum: 1st (1.0), 3rd (0.150), 5th (0.320), 7th (0.250), 9th (0.080), 11th (0.150), 13th (0.125), 15th (0.040)]

kVA	No Load		35% Load		Full Load	
	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)
300	0.5196	0.0000	1.2944	0.9878	8.4728	0.9725
500	0.7590	0.0000	1.9122	0.9892	12.6872	0.9753

c. Configuration:

1) kVA Rating: As indicated on drawings..
2) Primary Voltage: 480V.
3) Secondary Voltage: 208/120 V.
4) System Frequency: 60 Hz.
5) Primary winding configurations shall be “Delta” in order to ensure the required zero-sequence reactance and impedance. (“Wye” connected primary windings shall NOT be used.)
6) Secondary winding configurations shall be “Zig-Zag” for 0 degree phase shift HMTs and “Modified Zig-Zag” for all other phase shift HMTs in order to ensure that zero-sequence flux is completely cancelled under balanced zero-sequence loading.
7) Primary to Secondary Phase Shift: 0, minus 30, minus 15 and minus 45 primary to secondary phase shift degrees for a 24-pulse system.
8) Positive- and Negative-sequence impedance at 60 Hz shall be 3 to 6 percent
9) Zero-sequence reactance at 60 Hz shall be less than 0.2 percent.
10) Zero-sequence impedance at 60 Hz shall be less than 0.9 percent.
11) Crest Factor Suitability: 4.5
12) Neutral connection shall be rated at two times the ampacity of the secondary phase current.
13) Capability to deliver full nameplate kVA with a load K-factor up to K30.

d. Design shall be optimized for harmonic rich and high neutral current environment.
e. Harmonic cancellation shall be by electromagnetic means only. No capacitors or electronics shall be used.
f. Specifically designed to provide an ultra-low zero-sequence impedance (less than 0.9 percent) path for all zero-sequence currents (i.e. I3, I9, I15, I21,) in their three-phase, four-wire secondary windings regardless of phase shift. In addition, the transformer must perform all of the follow functions:

1) Provide for the cancellation of 5th, 7th, 17th, 19th, --- positive-sequence and negative-sequence harmonic currents at each transformer’s primary bus, equal to the lesser source of each individual harmonic current through each model, thereby treating all of the foregoing harmonic currents, when 0 degree and minus 30 degree or minus 15 degree and minus 45 degree phase shift transformers are used in combination.

2) Provide for the cancellation of 5th, 7th, 11th, 13th, 17th, 19th, --- positive-sequence and negative-sequence harmonic currents at each transformer's primary bus, equal to the lesser source of each individual harmonic current through each model, thereby treating all of the foregoing harmonic currents, when 0 degree, minus 20 degree and minus 40 degree phase shift transformers are used in combination.
3) Provide for the cancellation of 5th, 7th, 11th, 13th, 17th, 19th, 21st, 23rd, --- positive-sequence and negative-sequence harmonic currents at each transformer's primary bus, equal to the lesser source of each individual harmonic current through each model, thereby treating all of the foregoing harmonic currents, when 0 degree, minus 30 degree, minus 15 degree and minus 45 degree phase shift transformers are used in combination.

C. List and label as complying with UL 1561.

D. Provide transformers that are constructed to withstand seismic forces specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

E. Enclosure: Ventilated, NEMA 250, Type 3R, Indoor (Standard) unless otherwise indicated on Drawings.

1. The front and back covers of the enclosure shall be securely fastened using zinc plated, hexavalent chromium free, captive stainless-steel inserts and hex-head bolts. The use of self-tapping screws to secure the front and back covers is not permitted.

F. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: PQI White Powder Coat (standard).

G. Taps for Transformers 15 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature unless otherwise indicated on Drawings.

I. Wall Brackets: Manufacturer's standard wall mounting brackets shall be provided where indicated on Drawings.

J. Low-Sound-Level Requirements:

1. Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:

a. 9 kVA and Less: 40 dBA
b. 30 to 50 kVA: 45 dBA
c. 51 to 150 kVA: 50 dBA
d. 151 to 300 kVA: 53 dBA
e. 301 to 500 kVA: 55 dBA
f. 501 to 750 kVA: 62 dBA
g. 751 to 1000 kVA: 64 dBA

2.3 ACCESSORIES

A. Single Electrostatic Shield.

B. 200kA Transient Voltage Surge Suppression (TVSS) on the secondary side of the transformer.

2.4 IDENTIFICATION DEVICES

A. Manufacturer’s Nameplates: Nameplates (minimum of two required) for each distribution transformer shall be permanently affixed to the left and right side of each transformer enclosure so that the transformer remains permanently identified when front or back covers are removed. The placement of a single manufacturer nameplate on the front cover of the enclosure is unacceptable.

B. Identification Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer shall be used to identify the transformer name, kVA rating, source name, load name and feeder size for both primary and secondary. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Construct concrete bases and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 2250

SECTION 262416 - PANELBOARDS

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. Lighting and appliance branch-circuit panelboards.

B. Related Sections include the following:

   1. Section 260573.13 “Short-Circuit Study.”
   2. Section 260573.19 “Arc-Flash Hazard Analysis.”

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. MCCB: Molded-case circuit breaker.

E. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

   1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment. Submit the following for preliminary approval. Final approval will be given after the Short-Circuit Studies, Coordination Studies, and Arc-Flash Analysis are completed and approved.

   1. Include dimensioned plans, elevations, sections, and details.
   2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
   3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   4. Detail bus configuration, current, and voltage ratings.

5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include an Internet link for electronic access to downloadable PDF of the coordination curves.
10. Include Engineer of Record (EOR) approval of the arc-flash hazard analysis. Panelboards are not approved for release until final approval of the above studies by the EOR are provided.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E, “Standard for Electrical Safety in the Workplace.”

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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

C. Comply with NEMA PB 1, “Panelboards.”

D. Comply with NFPA 70, “National Electrical Code.”

E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

2. Height: 84 inches (2.13 m) maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.

4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Finishes:

    a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel.

F. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

    a. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

H. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

I. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Sector; Eaton Corporation.
2. ABB-GE Industrial Solutions.
3. Siemens Energy.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall be retained with screws. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. Siemens Energy.
4. Square D; a brand of Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
5. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    j. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
    k. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.4 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NECA 407 “Standard for Installing and Maintaining Panelboards”.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1, “Standard Practice for Good Workmanship in Electrical Construction.”

C. Install panelboards and accessories according to NECA 407.

D. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.

J. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

L. Install filler plates in unused spaces.

M. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.

N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 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. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Do not perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

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. Standard-grade receptacles, 125 V, 20 A.
2. Twist-locking receptacles.
3. Toggle switches, 120/277 V, 20 A.
4. Wall plates.

1.3 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

1.4 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.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 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 use.

B. Comply with NFPA 70, “National Electrical Code.”

C. RoHS compliant.

D. Comply with NEMA WD 1, “General Color Requirements for Wiring Devices.”

E. 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 requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Essential Electrical System: Red.
3. Isolated-Ground Receptacles: Orange.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

2.3 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Configuration: NEMA WD 6, Configuration as indicated on drawings.
3. Standards: Comply with UL 498.

2.4 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Standards: Comply with UL 20 and FS W-S-896.

2.5 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. 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: Steel with white baked enamel, suitable for field painting.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

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 comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace 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. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. 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.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles 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. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.

B. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Ground Impedance: Values of up to 2 ohms are acceptable.
3. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
4. Using the test plug, verify that the device and its outlet box are securely mounted.
5. 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 262726

SECTION 262813 - FUSES

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. Cartridge fuses rated 600 V ac and less for use in the following:

a. Enclosed switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software.
4. Coordination charts and tables and related data.
5. Fuse size for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software.
4. Coordination charts and tables and related data.

1.5 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton/Cooper Bussmann.
2. Eaton/Edison.
3. Littelfuse, Inc.
4. Mersen.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.

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

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70, “National Electrical Code.”

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.

4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Feeders: Class L, fast acting.
2. Motor Branch Circuits: Class RK1, time delay.
3. Large Motor Branch (601-4000 A): Class L, time delay.
4. Power Electronics Circuits: Class J, high speed.
5. Other Branch Circuits: Class RK1, time delay.
6. Control Transformer Circuits: Class CC, time delay, control transformer duty.
7. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.

2. Molded-case circuit breakers (MCCBs).
3. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

1.4 SPDT: Single pole, double throw.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with NFPA 70, “National Electrical Code.”

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. ABB-GE Industrial Solutions.
3. Siemens Industry, Inc.
4. Schneider Electric; Square D.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
5. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: [One] [Two] NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 24-V ac.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. ABB-GE Industrial Solutions.
3. Siemens Industry, Inc.
4. Schneider Electric; Square D.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for 167 deg F (75 deg C) rated wire.

G. Standards: Comply with UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

K. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

C. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E, “Standard for Electrical Safety in the Workplace.”

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

3.4 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function;

and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816

SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

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 separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Product Certificates: For each VFC from manufacturer.

D. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
b. Manufacturer's written instructions for setting field-adjustable overload relays.
c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. Eaton.
3. Schneider Electric USA, Inc.
4. Siemens Industry, Inc., Building Technologies Division.
5. Yaskawa Electric America, Inc.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

B. Application: variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 96 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
7. Ambient Temperature Rating: Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet (1000 m).
10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 5 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
8. Loss-of-phase protection.
9. Reverse-phase protection.
10. Short-circuit protection.
11. Motor-overtemperature fault.
12. Input power fuses dedicated for VFC drive unit..

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

M. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

N. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

O. Integral Input Disconnecting Means and OCPD: UL 489, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
3. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

2.3 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

a. A minimum of two programmable analog inputs: 0- to 10-V dc.

b. A minimum of six multifunction programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:

a. 0- to 10-V dc.
b. 4- to 20-mA dc.
c. Potentiometer using up/down digital inputs.
d. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of one programmable analog output signal(s) (4- to 20-mA dc), which can be configured for any of the following:

a. Output frequency (Hz).
b. Output current (load).
c. DC-link voltage (V dc).
d. Motor torque (percent).
e. Motor speed (rpm).
f. Set point frequency (Hz).

4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

a. Motor running.
b. Set point speed reached.
c. Fault and warning indication (overtemperature or overcurrent).
d. PID high- or low-speed limits reached.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: One.

G. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.

1. Hardwired Points:

a. Monitoring: On-off status.
b. Control: On-off operation.

2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.4 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic

voltage demand at the defined point of common coupling to meet IEEE 519 recommendations. As a minimum, provide 5 percent input reactor integral to the VFC.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.5 ENCLOSURES

A. VFC Enclosures: UL 50, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.6 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Control key pads.

B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

D. Supplemental Digital Meters:

1. Elapsed-time meter.
2. Kilowatt meter.
3. Kilowatt-hour meter.

E. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

2.7 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to its specified motor.
2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Floor-Mounting Controllers: Install VFCs on 4-inch (100-mm) nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."
2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in each fusible-switch VFC.

F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

I. Comply with NECA 1, “Standard Practice for Good Workmanship in Electrical Construction.”

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 CONDUIT CONNECTIONS:

A. Install all conduits into bottom of VFC enclosure. Input conductors must be in separate conduit from output conductors.

3.5 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. VFCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.7 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.

3.8 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

F. Set field-adjustable pressure switches.

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

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

END OF SECTION 262923

SECTION 263353 - STATIC UNINTERRUPTIBLE POWER SUPPLY

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 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section Includes:

1. Three-phase, on-line, double-conversion, static-type, UPS units with the following features:

a. Surge suppression.
b. Rectifier-charger.
c. Inverter.
d. Controls and indications.
e. Static bypass transfer switch.
f. Maintenance bypass/isolation switch.
g. Output distribution section.
h. Input isolation transformers.
i. Remote status and alarm panels.
j. Remote monitoring provisions.
k. Battery and battery disconnect device.
l. Battery monitoring.

B. Related Sections include the following:

1. Division 01 Sustainability Sections for additional requirements related to the LEED certification process.

1.4 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GTO: Gate turn-off thyristor.

C. IGBT: Isolated gate bipolar transistor.

D. LCD: Liquid-crystal display.

E. LED: Light-emitting diode.

F. PC: Personal computer.

G. SPD: Surge protection device.

H. THD: Total harmonic distortion.

I. UPS: Uninterruptible power supply.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of UPS.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for UPS.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For UPS.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.
4. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Factory Test Reports: Comply with specified requirements.

C. Product Test Reports: Indicate test results compared with specified performance requirements, and provide justification and resolution of differences if values do not agree.

D. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For UPS units to include in emergency, operation, and maintenance manuals.

B. Commissioning of a system or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner’s operation and maintenance personnel, is required in cooperation with the COTR and the Commissioning Authority. Project Closeout is dependent on successful completion of all

commissioning procedures, documentation, and issue closure. Refer to Division 01 Section "General Commissioning Requirements," for detailed commissioning requirements.

1.8 QUALITY ASSURANCE

A. Power Quality Specialist Qualifications: A registered professional electrical engineer or engineering technician, currently certified by the National Institute for Certification in Engineering Technologies, NICET Level 4, minimum, experienced in performance testing UPS installations and in performing power quality surveys similar to that required in "Performance Testing" Article.

B. Testing Qualifications: An agency or individual employed by the Contractor, with the experience and capability to conduct the testing indicated, that is a member of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 28 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing.

1.9 WARRANTY

A. Special Battery Warranties: Manufacturer and Installer agree to repair or replace UPS system storage batteries that fail in materials or workmanship within the battery manufacturers one year warranty period.

B. Special UPS Warranties: Specified form in which manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within special warranty period.

1. Special Warranty Period: One year after initial startup or 18 months after shipping date, whichever comes first.

PART 2 - PRODUCTS

2.1 OPERATIONAL REQUIREMENTS

A. Automatic operation includes the following:

1. Double Conversion, IGBT:

a. Normal Conditions: Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output. High-efficiency carrier stored trench IGBT, in both rectifier-charger and inverter circuits, provides a minimum of 94 percent efficiency for the UPS system at full load and a minimum of 95 percent efficiency at 50 percent load.
b. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to provide constant, regulated inverter power output to the load.

c. Power Failure: If normal power fails, the inverter uses energy from the battery to supply constant, regulated power output to the load without switching or disturbance.

2. When power is restored at the normal supply terminals of the system, controls shall automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger shall supply power to the load through the inverter and simultaneously recharge the battery.
3. If the battery becomes discharged and normal supply is available, the rectifier-charger shall charge the battery. The rectifier-charger shall automatically shift to float-charge mode on reaching full charge.
4. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch shall switch the load to the normal ac supply circuit without disturbance or interruption.
5. The output power converters shall produce up to 300 percent of rated full-load current for short-circuit clearing. The inverter shall sustain steady-state overload conditions of up to 150 percent of rated full-load current for 60 seconds in normal operation.
6. The inverter shall be capable of sustaining 150 percent of system capacity for 30 seconds while powered from the battery.
7. Should overloads persist past the time limitations, the automatic static transfer switch shall switch the load to the bypass output of the UPS. When the fault has cleared, the static bypass transfer switch shall return the load to the UPS system.
8. If the battery is disconnected, the UPS shall supply power to the load from the normal supply with no degradation of its regulation of voltage and frequency of the output bus.

B. Manual operation includes the following:

1. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal ac supply circuit without disturbance or interruption.
2. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.

C. Maintenance Bypass/Isolation Switch Operation: Switch is interlocked so it cannot be operated unless the static bypass transfer switch is in the bypass mode. Device provides manual selection among the three conditions described below without interrupting supply to the load during switching:

1. Full Isolation: Load is supplied, bypassing the UPS. Normal UPS ac input circuit, static bypass transfer switch, and UPS load terminals are completely disconnected from external circuits.
2. Maintenance Bypass: Load is supplied, bypassing the UPS. UPS ac supply terminals are energized to permit operational checking, but system load terminals are isolated from the load.
3. Normal: Normal UPS ac supply terminals are energized and the load is supplied through the static bypass transfer switch and the UPS rectifier-charger and inverter, or the battery and the inverter.

D. Environmental Conditions: The UPS shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability, except battery performance:

1. Ambient Temperature for Electronic Components: 0 to 40 deg C (32 to 104 deg F).
2. Ambient Temperature for Battery: 5 to 35 deg C (41 to 95 deg F).
3. Relative Humidity: Zero to 95 percent, noncondensing.
4. Altitude: Sea level to 1220 m (4000 feet).

2.2 PERFORMANCE REQUIREMENTS

A. UL Compliance: Listed and labeled by an NRTL to comply with UL 1778, Fourth edition.

B. The UPS shall perform as specified in this article while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a maximum load crest factor of 3.0, under the following conditions or combinations of the following conditions:

1. Inverter is switched to battery source.
2. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.
3. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.
4. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.
5. Load is 30 percent unbalanced continuously.

C. Minimum Duration of Supply: If battery is sole energy source supplying rated full-load UPS current at 80 percent power factor, duration of supply is 30 minutes for IT and 30 minutes for OPS.

D. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 20 percent and minus 15 percent from nominal voltage.

E. Overall UPS Efficiency: Equal to or greater than 94 percent at 100 percent load, 94 percent at 75 percent load, and 93 percent at 25 percent load.

F. Maximum Energizing Inrush Current: 1.5 times the rated current.

G. AC Output-Voltage Regulation for Loads 100 Percent Unbalanced: Maximum of plus or minus 2 percent over the full range of battery voltage.

H. AC Output-Voltage Regulation for Loads 100 Percent Balanced: Maximum of plus or minus 1 percent over the full range of battery voltage.

I. Output Frequency: 60 Hz, plus or minus 0.1 percent over the full range of input voltage, load, and battery voltage.

J. Limitation of harmonic distortion of input current to the UPS shall be as follows:

1. Description: Rectifier-charger circuits shall limit THD to 5 percent, maximum, at rated full-load UPS current, for power sources with X/R ratio between 2 and 30. Provide tuned harmonic filter if required to meet harmonic distortion limit.

K. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for rated full load with THD up to 50 percent, with a load crest factor of 3.0.

L. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, 150 percent for 60 seconds in normal operation, and 150 percent for 30 seconds in battery operating mode.

M. Maximum Output-Voltage Transient Excursions from Rated Value: For the following instantaneous load changes, stated as percentages of rated full UPS load, voltage shall remain within stated percentages of rated value and recover to, and remain within, plus or minus 2 percent of that value within 50 ms:

1. 50 Percent: Plus or minus 3 percent.
2. 100 Percent: Plus or minus 5 percent.
3. Loss of AC Input Power: Plus or minus 1 percent.
4. Restoration of AC Input Power: Plus or minus 1 percent.

N. Input Power Factor: A minimum of 0.95 lagging when supply voltage and current are at nominal rated values and the UPS is supplying rated full-load current without additional filters.

O. Output Power Factor Rating: Loads with power factor of 0.9 leading to 0.8 lagging shall not require derating of the UPS. For loads with power factors outside this range, derate the UPS output as follows:

1. Derate the UPS a maximum of 5 percent for 0.7 PF lagging.
2. Derate the UPS a maximum of 10 percent for 0.6 PF lagging.
3. Derate the UPS a maximum of 15 percent for 0.5 PF lagging.
4. Derate the UPS a maximum of 20 percent for a range of 0.4 to 0.1 PF lagging.

P. EMI Emissions: Comply with FCC rules and regulations and with 47 CFR 15 for Class A equipment.

2.3 UPS SYSTEMS

A. Description: Self-contained, battery backup device and accessories that provides three-phase electrical power in the event of failure or sag in the normal power system.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Liebert; a brand of Emerson Electric Co.
2. APC by Schneider Electric.
3. Eaton.
4. Mitsubishi Electric Automation, Inc.
5. General Electric.
6. Solar Edge.

C. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.

D. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.

E. Configuration: Multicabinet modular style units.

F. Control Assemblies: Mount on modular plug-ins, readily accessible for maintenance.

G. Maintainability Features: Mount rectifier-charger and inverter sections and the static bypass transfer switch on modular plug-ins, readily accessible for maintenance.

H. 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.

I. UPS Cabinet Ventilation: Redundant fans or blowers draw in ambient air near the bottom of cabinet and discharge it near the top rear.

2.4 SURGE SUPPRESSION

A. Protect internal UPS components from surges that enter at each ac power input connection including main disconnect switch, static bypass transfer switch, and maintenance bypass/isolation switch. Protect rectifier-charger, inverter, controls, and output components.

1. Use factory-installed surge suppressors tested according to IEEE C62.41.1 and IEEE C62.41.2, Category B.
2. Additional Surge Protection: Protect internal UPS components from low-frequency, high-energy voltage surges described in IEEE C62.41.1 and IEEE C62.41.2. Design the circuits connecting with external power sources and select circuit elements, conductors, conventional surge suppressors, and rectifier components and controls so input assemblies will have adequate mechanical strength and thermal and current-carrying capacity to withstand stresses imposed by 400-Hz, 180 percent voltage surges described in IEEE C62.41.1 and IEEE C62.41.2.

2.5 RECTIFIER-CHARGER

A. Description: Voltage source converter, six-pulse IGBT rectifier.

B. Capacity: Adequate to supply the inverter during rated full output load conditions and simultaneously recharge the battery from fully discharged condition to 95 percent of full charge within 10 times the rated discharge time for duration of supply under battery power at full load.

C. Output Ripple: Limited by output filtration to less than 0.5 percent of rated current, peak to peak.

D. Control Circuits: Immune to frequency variations within rated frequency ranges of normal and emergency power sources.

1. Response Time: Field adjustable for maximum compatibility with local generator-set power source.

E. Battery Float-Charging Conditions: Comply with battery manufacturer's written instructions for battery terminal voltage and charging current required for maximum battery life. The battery charger shall be matched to the battery type supplied.

2.6 INVERTER

A. Description: Pulse-width modulated, carrier stored trench IGBT with sinusoidal output. Include a bypass phase synchronization window adjustment to optimize compatibility with local engine-generator-set power source.

2.7 CONTROLS AND INDICATIONS

A. Description: Group displays, indications, and basic system controls on a common control panel on front of UPS enclosure.

B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms include audible signals and visual displays.

C. Indications: Plain-language messages on a digital LCD.

1. Quantitative indications shall include the following:

a. Input voltage, each phase, line to line.
b. Input current, each phase, line to line.
c. Bypass input voltage, each phase, line to line.
d. Bypass input frequency.
e. System output voltage, each phase, line to line.
f. System output current, each phase.
g. System output frequency.
h. DC bus voltage.
i. Battery current and direction (charge/discharge).
j. Elapsed time discharging battery.
k. Load kW.
l. Load kVA.

2. Basic status condition indications shall include the following:

a. Normal operation.
b. Load-on bypass.
c. Load-on battery.
d. Inverter off.
e. Alarm condition.

3. Alarm indications shall include the following:

a. Bypass ac input overvoltage or undervoltage.
b. Bypass ac input overfrequency or underfrequency.
c. Bypass ac input and inverter out of synchronization.
d. Bypass ac input wrong-phase rotation.
e. Bypass ac input single-phase condition.
f. Bypass ac input filter fuse blown.
g. Battery system alarm.
h. Control power failure.
i. Fan failure.

j. UPS overload.
k. Battery-charging control faulty.
l. Input overvoltage or undervoltage.
m. Input transformer overtemperature.
n. Input circuit breaker tripped.
o. Input wrong-phase rotation.
p. Input single-phase condition.
q. Approaching end of battery operation.
r. Battery undervoltage shutdown.
s. Maximum battery voltage.
t. Inverter fuse blown.
u. Inverter transformer overtemperature.
v. Inverter overtemperature.
w. Static bypass transfer switch overtemperature.
x. Inverter power supply fault.
y. Inverter transistors out of saturation.
z. Identification of faulty inverter section/leg.
aa. Inverter output overvoltage or undervoltage.
bb. UPS overload shutdown.
cc. Inverter current sensor fault.
dd. Inverter output contactor open.
ee. Inverter current limit.

4. Controls shall include the following:

a. Inverter on-off.
b. UPS start.
c. Battery test.
d. Alarm silence/reset.
e. Output-voltage adjustment.

D. Dry-form "C" contacts shall be available for remote indication of the following conditions:

1. UPS on battery.
2. UPS on-line.
3. UPS load-on bypass.
4. UPS in alarm condition.
5. UPS off (maintenance bypass closed).

E. Emergency Power off Switch: Capable of local operation and operation by means of activation by external dry contacts.

2.8 STATIC BYPASS TRANSFER SWITCH

A. Description: Solid-state switching device providing uninterrupted transfer with a contactor or electrically operated circuit breaker to automatically provide electrical isolation for the switch.

B. Switch Rating: Continuous duty at the rated full-load UPS current, minimum.

C. Input SPD: 160 kA.

2.9 MAINTENANCE BYPASS/ISOLATION SWITCH

A. Description: Manually operated switch or arrangement of switching devices with mechanically actuated contact mechanism arranged to route the flow of power to the load around the rectifier-charger, inverter, and static bypass transfer switch.

1. Switch shall be electrically and mechanically interlocked to prevent interrupting power to the load when switching to bypass mode.
2. Switch shall electrically isolate other UPS components to permit safe servicing.
3. Switch shall electrically isolate the rectifier-charger, inverter, and static bypass transfer switch from the load, but shall allow primary power to the UPS for testing.

B. Comply with NEMA PB 2 and UL 891.

C. Switch Rating: Continuous duty at rated full-load UPS current.

D. Mounting Provisions: Separate floor-mounted unit.

E. Key interlock with key that is released only when the rectifier-charger and inverter are bypassed by the static bypass transfer switch. Key shall be required to unlock maintenance bypass/isolation switch before switching from open (normal) position to closed position. Lock shall be designed specifically for mechanical and electrical component interlocking.

2.10 INPUT ISOLATION TRANSFORMER

A. Description: Shielded unit with low forward transfer impedance up to 3 kHz, minimum and 208/120-volt, 3 phase output. Include the following features:

1. Comply with applicable portions of UL 1561, including requirements for nonlinear load current-handling capability for a K-factor of approximately 20.
2. Output Impedance at Fundamental Frequency: Between 3 and 4 percent.
3. Regulation: 5 percent, maximum, at rated nonlinear load current.
4. Full-Load Efficiency at Rated Nonlinear Load Current: 96 percent, minimum.
5. Electrostatic Shielding of Windings: Independent for each winding.
6. Coil Leads: Physically arranged for minimum interlead capacitance.
7. Shield Grounding Terminal: Separately mounted; labeled "Shield Ground."
8. Capacitive Coupling between Primary and Secondary: 33 pF, maximum, over a frequency range of 20 Hz to 1 MHz.

2.11 OUTPUT DISTRIBUTION PANELBOARD

A. Description: Panelboard shall be 208/120V with individually mounted circuit breakers as scheduled on Contract drawings.

2.12 REMOTE STATUS AND ALARM PANEL

A. Description: Labeled LEDs on panel faceplate indicating five basic status conditions. Audible signal indicates alarm conditions. Silencing switch in face of panel silences signal without altering visual indication.

1. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

2.13 REMOTE MONITORING

A. Description: Communication module in unit control panel provides capability for remote monitoring of status, parameters, and alarms specified in "Controls and Indications" Article. The remote computer and the connecting signal wiring are not included in this Section. Include the following features:

1. Connectors and network interface units for data transmission via RS-485, Ethernet, or web-based link.
2. Software designed for control and monitoring of UPS functions and to provide on-screen explanations, interpretations, diagnosis, action guidance, and instructions for use of monitoring indications and development of meaningful reports. Permit storage and analysis of power-line transient records. Designs for Windows applications, software, and computer are not included in this Section.

2.14 BATTERY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. C&D Technologies, Inc.
2. Eaton.
3. EnerSys.
4. Panasonic Corporation of North America; Panasonic Industrial Company.

B. Description: Lithium ion.

1. Factory assembled in an isolated compartment of UPS cabinets.
2. Arrange for drawout removal of battery assembly from cabinet for testing and inspecting.
3. Battery shall utilize absorbent glassmat (AGM) technology to immobile electrolyte.

2.15 BASIC BATTERY MONITORING

A. Description: Continuous, real-time capture of battery performance data.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alber.
2. BTECH, Inc.
3. Eaton.

C. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.

D. Battery compartment high-temperature detector initiates an alarm when smoke or a temperature greater than 75 deg C (167 deg F) occurs within the compartment.

E. Annunciation of Alarms: At UPS control panel and remotely.

2.16 SOURCE QUALITY CONTROL

A. Factory test complete UPS system before shipment. Use simulated battery testing. Include the following:

1. Test and demonstration of all functions, controls, indicators, sensors, and protective devices.
2. Full-load test.
3. Transient-load response test.
4. Overload test.
5. Power failure test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the UPS.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Verify installation conditions are representative of the conditions used in the coordination studies for the electrical system. Provide fuse protection according to Section 262813 "Fuses" if required for coordination with UPS overcurrent protective device requirements.

3.2 INSTALLATION

A. Comply with NECA 1, “Standard Practice for Good Workmanship in Electrical Construction.”

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Equipment Mounting: Install UPS on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 450-mm (18-inch) centers around the full perimeter of concrete base 150 mm (6 inches) from the outer edge of the base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

E. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

F. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated. Apply oxide inhibitor on battery terminals.

3.3 GROUNDING

A. Separately Derived Systems: Comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near isolation transformer. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify each battery cell individually.

3.5 BATTERY EQUALIZATION

A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

3.6 FIELD QUALITY CONTROL

A. Functional Performance & Integrated Systems Testing is part of the Commissioning process and shall be performed by the Contractor and witnessed and documented by the Commissioning Authority.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Tests and Inspections:

1. Inspect interiors of enclosures, including the following:

    a. Inspect anchorage, alignment, grounding, and required clearances.
    b. Component type and labeling verification.
    c. Ratings of installed components.

2. Test electrical and mechanical interlock systems for correct operation and sequencing.
3. Inspect bolted electrical connections for high resistance using one or more of the following methods:

    a. Use of low-resistance ohmmeter according to Section 7.22.2.2 of NETA ATS.
    b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or Table 100.12 of NETA ATS.
    c. Perform thermographic survey according to Section 9 of NETA ATS.

4. Test static transfer from inverter to bypass and back. Use normal load, if possible.
5. Test dc undervoltage trip level on inverter input breaker. Set according to manufacturer's published data.
6. Verify synchronizing indicators for static switch and bypass switches.

7. Test insulated-case and molded-case breakers.

    a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed, and across each open pole. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 of NETA ATS.
    b. Perform insulation-resistance tests on all control wiring for ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid-state components, follow manufacturer's recommendation.
    c. Use primary current injection to determine long time and short time, ground fault, and instantaneous pickup, Use secondary current injection to test trip functions.
    d. Perform minimum pickup voltage tests on shunt trip and close coils according to manufacturer's published data.
    e. Verify operation of charging mechanism.
    f. Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, antipump function, and trip unit battery condition. Reset all trip logs and indicators.

8. Test automatic transfer switches.

    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter, if applicable, according to Section 7.22.3.1 of NETA ATS.
    b. Perform insulation-resistance tests on all control wiring for ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid-state components or for control devices that cannot tolerate the applied voltage, follow manufacturer's recommendation.
    c. Perform a contact/pole-resistance test.
    d. Verify settings and operation of control devices.
    e. Calibrate and set all relays and timers according to Section 7.9 of NETA ATS.
    f. Verify phase rotation, phasing, and synchronized operation as required by the application.
    g. Perform automatic transfer tests.

        1) Simulate loss of normal power.
        2) Return to normal power.
        3) Simulate loss of emergency power.
        4) Simulate all forms of single-phase conditions.

    h. Verify correct operation and timing of the following functions:

        1) Normal source voltage-sensing and frequency-sensing relays.
        2) Time delay on transfer.
        3) Alternative source voltage-sensing and frequency-sensing relays.
        4) Automatic transfer operation.
        5) Interlocks and limit switch function.
        6) Time delay and retransfer on normal power restoration.

9. Test direct current system's batteries.

a. Verify adequacy of battery support racks, mounting, anchorage, alignment, grounding, and clearances.
b. Inspect spill containment installation. Measure charger float and equalizing voltage levels. Adjust to battery manufacturer's recommended settings.
c. Verify all charger functions and alarms.
d. Measure each cell voltage and total battery voltage with charger energized and in float mode of operation.
e. Perform a load test according to manufacturer's published data or IEEE 450.
f. Measure charger float and equalizing voltage levels. Adjust to battery manufacturer's recommended settings.
g. Test values.

1) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
2) Charger float and equalize voltage levels shall be according to battery manufacturer's published data.
3) The results of charger functions and alarms shall be according to manufacturer's published data.
4) Cell voltages shall be within 0.05 V of each other or according to manufacturer's published data.
5) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
6) Cell internal ohmic values (resistance, impedance, or conductance) shall not vary by more than 25 percent between identical cells that are in a fully charged state.
7) Results of load tests shall be according to manufacturer's published data or IEEE 450.

D. The UPS system will be considered defective if it does not pass tests and inspections.

E. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

F. Prepare test and inspection reports.

3.7 MANUFACTURER’S FIELD SERVICE

A. The UPS manufacturer shall directly employ a nationwide service organization, consisting of factory-trained field service personnel dedicated to the startup and maintenance of UPS and power equipment.

B. If emergency service is required, on-site response time shall be 5 hours or less within 150 miles of service center.

3.8 TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with COTR. Provide competent, factory authorized personnel to provide instructions to operation

and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instructions shall be scheduled in coordination with the COTR after submission and approval of format training plans.

END OF SECTION 263353

SECTION 263600 - TRANSFER SWITCHES

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 UNITS OF MEASURE

A. Contractor to Note: Per SI direction units of measure have been listed in both Metric and Imperial Units, with the metric unit listed first. The metric units are nominal and may not be in agreement with dimensioning on drawings. In cases of conflict the Imperial unit of measure shall govern. Contractor to note that for purposes of the work, Imperial refers to United States Customary Units.

1.3 SUMMARY

A. Section includes automatic transfer switches rated 600 V and less, including the following:

1. Bypass/isolation switches.
2. Remote annunciator system.
3. Monitoring of Engine Start Control Wiring per 2017 NEC article 700.10(D)(3).

B. Related Sections include the following:

1. Division 01 Sustainability Sections for additional requirements related to the LEED certification process.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports: For field quality-control procedures to include in maintenance manual submittal.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section “Closeout Procedures," include the following:

a. Features and operating sequences, both automatic and manual.
b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.7 QUALITY ASSURANCE

A. Testing Qualifications: An agency or individual employed by the Contractor, with the experience and capability to conduct the testing indicated, that is a member of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 28 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing.

1.8 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify COTR no fewer than five days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without COTR written permission.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. Comply with NEMA ICS 1, “Industrial Control and Systems, General Requirements.”

C. Comply with NFPA 110, “Standard for Emergency and Standby Power System.”

D. Comply with UL 1008 unless requirements of these Specifications are stricter.

E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Short-time withstand capability for three cycles.

G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C (minus 4 to plus 158 deg F).

H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism.

J. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, generator control panels and BAS shall have communication capability matched with remote device.

K. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed shrinkable sleeve markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via front access.

L. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

M. Monitoring of Engine Start Control Wiring:

1. Must meet and fully comply with the 2017 NEC article 700.10(D)(3) code.
2. ATS shall provide continuous monitoring of the entire remote generator start circuit. Visual and audible annunciation of generator malfunction shall be initiated if the integrity of the start circuit is compromised.
3. The detection of a compromised start circuit shall initiate and latch the generator starting circuit.
4. Each engine start channel must have its own dedicated switch with ability to enable or disable monitoring function.
5. The engine start circuit shall be a single pair of typical hard wire.
6. Coordinate placement of required components within the generator controls with the generator manufacturer.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Asco; Emerson.
2. Eaton.
3. GE Zenith Controls.
4. Kohler Power Systems.
5. Russelectric. Inc.

B. Comply with Level 2 equipment according to NFPA 110.

C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Material: Hard-drawn copper, 98 percent conductivity.
6. Main and Neutral Lugs: Compression type.
7. Ground bar.
8. Connectors shall be marked for conductor size and type according to UL 1008.

D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.

1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

E. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

F. Digital Communication Interface: Matched to capability of remote annunciator, control panel for generators, and BAS via MODBUS RTU.

G. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Dry Contacts: Two single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

b. Push-button programming control with digital display of settings.
c. Integral battery operation of time switch when normal control power is unavailable.

H. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 5 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 5 percent maximum voltage difference.

2.3 TRANSFER SWITCH ACCESSORIES

A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 2 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
d. Transition: Provide closed-transition operation when transferring from main transfer switch to bypass/isolation switch on the same power source.
e. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
f. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
g. Automatic and Nonautomatic Control: Automatic transfer-switch controller shall also control the bypass/isolation switch.
h. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
i. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

B. Remote Annunciator System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
3. Annunciation panel display shall include the following indicators:

    a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
    b. Switch position.
    c. Switch in test mode.
    d. Failure of communication link.

4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

    a. Indicating Lights: Grouped for each transfer switch monitored.
    b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
    c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
    d. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.4 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:

    a. Overvoltage.
    b. Undervoltage.
    c. Loss of supply voltage.
    d. Reduction of supply voltage.
    e. Alternative supply voltage or frequency is at minimum acceptable values.
    f. Temperature rise.
    g. Dielectric voltage-withstand; before and after short-circuit test.
    h. Overload.
    i. Contact opening.
    j. Endurance.
    k. Short circuit.
    l. Short-time current capability.
    m. Receptacle withstand capability.
    n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wall-Mounting Switch: Anchor to wall by bolting.

1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
3. Provide workspace and clearances required by NFPA 70.

B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.

C. Identify components according to Section 260553 "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Comply with NECA 1, “Standard Practice for Good Workmanship in Electrical Construction.”

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Route and brace conductors according to manufacturer's written instructions and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.

G. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 457 mm (18 inches) in length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:

    a. Compare equipment nameplate data with Drawings and Specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, grounding, and required clearances.
    d. Verify that the unit is clean.
    e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
    f. Verify that manual transfer warnings are attached and visible.
    g. Verify tightness of all control connections.
    h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

        1) Use of low-resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

    i. Perform manual transfer operation.
    j. Verify positive mechanical interlocking between normal and alternate sources.
    k. Perform visual and mechanical inspection of surge arresters.
    l. Inspect control power transformers.

        1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
        2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
        3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:

    a. Perform insulation-resistance tests on all control wiring with respect to ground.
    b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
    c. Verify settings and operation of control devices.
    d. Calibrate and set all relays and timers. All relay and time delay settings and adjustments are to be completed prior to any commissioning of the ATS switches.
    e. Verify phase rotation, phasing, and synchronized operation.
    f. Perform automatic transfer tests.
    g. Verify correct operation and timing of the following functions:

        1) Normal source voltage-sensing and frequency-sensing relays.

2) Engine start sequence.
3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

   a. Check for electrical continuity of circuits and for short circuits.
   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
   c. Verify that manual transfer warnings are properly placed.
   d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

   a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
   f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

D. Coordinate tests with tests of generator and run them concurrently.

E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

F. Transfer switches will be considered defective if they do not pass tests and inspections.

G. Remove and replace malfunctioning units and retest as specified above.

H. Prepare test and inspection reports. Submit reports to COTR for final approval.

I. Functional Performance & Integrated Systems Testing is part of the commissioning process. Functional Performance & Integrated Systems Testing shall be performed by the contractor and witnessed and documented by the Commissioning Authority. Refer to Division 01 Section

"General Commissioning Requirements," for functional performance and integrated systems testing and commissioning requirements.

3.4 DEMONSTRATION

A. Training of the Owner's operation and maintenance personnel is required in cooperation with the COTR. Provide competent factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the COTR after submission and approval of formal training plans. Refer to Division 01 Section "Demonstration and Training," and Division 01 Section "General Commissioning Requirements," for contractor training requirements.

B. Coordinate this training with that for generator equipment. Provide a minimal of eight (8) hours for training.

END OF SECTION 263600

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the following types of LED luminaires:
   1. Downlight.
   2. Linear industrial.
   3. Materials.
   4. Luminaire support.

B. Related Requirements:

   1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
   2. Section 26 09 43.16 "Addressable-Luminaire Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Arrange in order of luminaire designation.
   2. Include data on features, accessories, and finishes.
   3. Include physical description and dimensions of luminaires.
   4. Include emergency lighting units, including batteries and chargers.

5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests[, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing laboratory providing photometric data for luminaires.

B. Product Certificates: For each type of luminaire.

C. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
2. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

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

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

2.2 DOWNLIGHT

A. 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.
1. indicated.

B. Standards:

1. RoHS compliant.
2. Recessed luminaires shall comply with NEMA LE 4.

2.3 LINEAR INDUSTRIAL

A. Standards:

1. RoHS compliant.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A 36/A 36M for carbon structural steel.
2. ASTM A 568/A 568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A 240/240 M.

D. Galvanized Steel: ASTM A 653/A 653M.

E. Aluminum: ASTM B 209.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1, “Standard Practice for Good Workmanship in Electrical Construction.”

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Suspended Luminaires:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exit signs.
2. Materials.
3. Luminaire support components.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire" Paragraph.

D. Lumen: Measured output of lamp and luminaire, or both.

E. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.
4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1. Product Data: Indicating luminaire is certified by ENERGY STAR.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing laboratory providing photometric data for luminaires.

B. Product Test Reports: For each luminaire for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

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

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.3 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1, “Standard Practice for Good Workmanship in Electrical Construction.”

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Luminaire will be considered defective if it does not pass operation tests and inspections.

B. Prepare test and inspection reports.

END OF SECTION 265213

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Conditions, Drawings, and Division 1, General Requirements, of the contract govern the work of this section.

1.2 SUMMARY

A. This specification is to be used as a base document in conjunction with all other Contract Division 27 specifications for the installation of a complete communications system. Section includes:

1. Technical Standards
2. Definitions
3. General Administrative Requirements
4. Submittals
5. Quality assurance
6. Warranty
7. Material Delivery, storage, and handling
8. Substitutions
9. Examination
10. Demolition
11. Installation
12. Field quality control
13. Project closeout and record documents

B. Related Specifications

1. Divisions-02 through -49 Sections for Work to be performed to complete Division-27 requirements.

2. Division 27 Specifications:

a. Section 271500 “Communications Horizontal Cabling” for work associated with communications cable distribution to Work Area Outlets.

1.3 TECHNICAL STANDARDS

A. All designs and installations shall be done in accordance with the following codes and standards. The codes and standards are minimum requirements. The most stringent requirement between

the codes, standards and the Contract documents shall be followed. The contractor is responsible for the research of all codes, standards, and regulations, including federal, state and local, which are applicable to the project. All work shall comply with the requirements of the latest edition of codes and regulations in use by the local jurisdiction at the time of the design and installation.

NFPA 70 National Electric Code (NEC)

NFPA 75 Protection of Information Technology Equipment

Underwriter's Laboratories (UL): Applicable listing and ratings.

BICSI TDMM "Telecommunications Distribution Methods Manual"

TIA-526-7 Revision A Measurement of Optical Power Loss of Installed SingleMode Fiber Cable Plant

TIA-526-14 Revision C Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant

TIA-568.0-D Generic Telecommunications Cabling for Customer Premises

TIA-568.1-D Commercial Building Telecommunications Infrastructure Standard

TIA-568.2-D Balanced Twisted-pair Telecommunications Cabling and Components Standards

TIA-568.3-D Optical Fiber Cabling Components Standard

TIA-568.4-D Broadband Coaxial Cabling and Components Standard

TIA-569-D Telecommunications Pathways and Spaces

TIA-606-C Administration Standard for Telecommunications Infrastructure

TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises

TIA-758 Revision B Customer-Owned Outside Plant Telecommunications Infrastructure Standard

1.4 DEFINITIONS

A. General: Basic Contract definitions are included in the Division 01-27 Sections and other Contract Documents.

B. The following list of terms used in this Specification shall be defined as follows:

1. "AHJ": Authority Having Jurisdiction
2. "ANSI": American National Standards Institute
3. "Contractor": Telecommunications Installation Company
4. "COR": Contracting Officer's Representative.
5. "COTS": Commercial Off the Shelf
6. "TIA": Telecommunications Industry Association
7. "TS": Telecommunications Space-Telecom Room, Equipment Room, IDF, MDF

1.5 GENERAL ADMINISTRATIVE REQUIREMENTS

A. The installation shall be done in accordance with all codes and regulations of the Authority Having Jurisdiction (AHJ).
B. The contractor shall have the proper licensing and provide all necessary permits and inspections required by the AHJ and the local jurisdictions.
C. The contractor shall provide all necessary parts, tools, equipment, and labor to install a complete and functional structured cable system per the contract documents, specifications, and drawings.
D. The contractor shall have experience in the structured cable plant installation business for at least five (5) continuous years. References for 3 projects of similar size, complexity, and length of performance are required.
E. The contractor shall have BICSI certified technicians performing the installation work or have at least 10 years of installation experience in Smithsonian Institution buildings.
F. Unless waived by Smithsonian's OCIO Network Management Division, the contractor shall be a Certified Partner of the Manufacturer's parts being installed. The proper number or percentage of technicians performing the installation shall have the Manufacturer's certification per the Manufacturer's requirements.

1.6 SUBMITTALS

A. All submittals shall be in accordance with the Contract, Division 01 and 27 requirements.
B. Submit manufacturer's written detailed technical product information and specifications for each type of product proposed for installation. Each submittal shall be marked with the section and paragraph numbers of the corresponding specification. Transmit all submittals to the COR or COR's designee. Written approval shall be received from the COR for the product prior to release of order for the products and equipment. At a minimum, include products listed in the Division-27 Specifications. Include all relevant products that will be installed, whether listed or not in the Specifications.
C. Submit the parts of a system or assembly, which require many parts to make a whole, together.
D. Submit shop drawings per the Contract requirements or if the proposed installation differs from the Contract Documents, the design intent, or as requested by the COR.
E. Allow 15 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
F. As-built documentation shall fully represent actual installed conditions and shall incorporate revisions made during the course of construction. Submit as part of close-out submittal.

G. Provide final test results for all cabling as part of the close-out submittal. Provide Manufacturer's warranty for installed cable plant.

1.7 QUALITY ASSURANCE

A. Materials and equipment furnished shall be new, unused and without defects. Furnish only specified products and equipment that have been approved in writing by the COR. The materials installed shall be consistent during the entire project.
B. Provide materials and equipment produced as standard products by a manufacturer regularly engaged in producing the specified materials and equipment.
C. All items including cables, faceplates, patch panels, racks/cabinets, and bonding equipment shall be labeled in accordance with OCIO labeling requirements and ANSI/TIA 606-C labeling standards. All means of labeling/identification shall be visible and clearly identifiable by OCIO personnel. All labels shall be machine generated or engraved. All labels shall be constructed and attached by means to ensure the lifespan of the label to be equal or greater than that of the device being identified.
D. The contractor shall provide a Project Manager for the duration of the project to coordinate the installation and provide the necessary documentation. Coordination services, procedures and documentation responsibility shall include, but shall not be limited to the items listed in this section.
E. Contractor shall comply with all the technical standards and specifications listed in this document and the contract.

1.8 WARRANTY

A. Telecommunications cable system, as specified in this Section, shall carry a minimum 20 year extended system and applications warranty. The extended warranty shall cover parts and labor for the duration of the extended warranty. The extended warranty shall also cover electrical performance of the twisted pair cabling system to the specific category per ANSI/TIA 568-D performance criteria for cabling. Contractor shall warrant installed hardware, under normal use and service, to be free from defects and faulty workmanship during the warranty period.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to Division 27 sections for approved products or specifications.
B. All materials and equipment shall be manufactured by a manufacturer that regularly and presently produce the materials and equipment specified for this project. The manufacturer shall have been in business for more than five years. The materials and equipment shall be standard COTS and replacements shall be readily available.

C. The materials provided for the “link” shall meet the required Contract specifications and documents and be either from the same manufacturer or be part of a warrantied system in which two manufacturers’ warranty a system together.

2.2 MATERIAL DELIVERY, STORAGE AND HANDLING

A. Protect equipment and materials during shipping, storage, and handling to prevent damage. Equipment and materials shall be protected against physical damage, dirt, moisture, humidity, and temperature.
B. Store materials in a clean, dry, ventilated space. Do not store equipment and materials outside of manufacturer’s specified environmental conditions. Storage outdoors covered by rainproof material is not acceptable.
C. Deliver materials in manufacturer's original, unopened, undamaged packaging with identification labels intact.
D. Do not install damaged equipment and materials. Remove from site and replace with new. Dents and paint damage to racks and cabinets shall be refinished or switched out for new at the discretion of the COR.
E. All risk of damage will remain with the Contractor until project completion and acceptance of the installation by the COR. Before that time, the Contractor is solely responsible for theft, loss, and damage of equipment and materials.

2.3 SUBSTITUTIONS

A. Do not provide substitution material, processes or equipment without written authorization from the COR.
B. Requests for substitutions shall adhere to the general requirements and procedures outlined in Division 01.
C. Where items are noted as "or comparable", a product of equivalent function, design, construction, quality and performance will be considered. Include in the substitution request: catalog cuts, product information, and pertinent test data required to substantiate that the product is in fact equivalent to that specified. Only one substitution will be considered for each product specified.
D. Substitutions shall be equivalent, in the opinion of the COR, to the specified product. The burden of proof of such shall rest with the Contractor. When the COR in writing accepts a substitution, it is with the understanding that the Contractor guaranteed the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the Work, or from any provisions of the Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examination of the site conditions is the responsibility of the Contractor. Examine conditions for compliance with requirements of other sections in which related work is specified and determine if conditions for Division 27 installation to proceed are satisfactory. Do not proceed if conditions are unsatisfactory and notify the COR. This includes pathways, conduits, and boxes.
B. Verify conditions are acceptable for product installation in accordance with Contract and manufacturer's requirements. For manufacturer, verify environmental conditions are within the parameters and pathway supports are properly installed.
C. Verify all fire rated walls being penetrated have a properly installed and rated fire stop assembly.

3.2 DEMOLITION

A. Coordinate all utility outages with the COR per Division-01 requirements.
B. All telecommunications cabling which will be not be retained in the demo/reno areas for continued use, or salvaged for reuse, or maintained in continuous operation shall be disconnected from termination devices and completely removed from device end-point to point of origin.
C. Develop a written project schedule listing the timing of work that will affect occupied areas. Provide the schedule to the COR for verification of acceptability. Work shall not proceed until acceptance is given by the COR.

3.3 INSTALLATION

A. Comply with all applicable codes and standards as listed under the Technical Standards of this Section.
B. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

    1. Maintain jobsite file and comply with MSDS for each product delivered to jobsite.

C. Coordinate installation work with the General Contractor to meet the construction schedule. Attend construction meetings as necessary to fulfill this requirement.
D. Protect installed products, surrounding areas, and finish surfaces from damage during construction activities. Provide temporary coverings on surfaces for protection from dust and construction / installation debris. Outlets, patch panels, fiber connections and housings, and cabinets shall be protected from dust infiltration.
E. Clean the Project site daily. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials.
F. Review installed work in conjunction with the General Contractor and develop a punch list for items needing correction. Provide punch list to the COR for review prior to the acceptance walk-thru.
G. TRs need to be finished and turned over to OCIO before the rest of the project's spaces are completed. The date of turnover will be decided by OCIO and Smithsonian Facilities before the project begins and needs to be maintained on the project schedule. At the time of turnover, the TRs need to be complete, dust free, and access controlled. Electrical and HVAC needs to be operational. Spaces around the TR shall also be finished to the level of being dust free. No work is allowed in the TRs and dust mitigation needs to be provided by the General Contractor or

Contractor to prevent adjacent construction zone work's dust from entering the TRs once the TR is turned over.

3.4 FIELD QUALITY CONTROL

A. Provide a qualified Field Supervisor who is a BICSI Certified Technician in charge of the Work and is present at the job site during all times Work is being performed or who has 10 years of experience working in conjunction with OCIO on Smithsonian Institution projects. Perform the installation within the restraints of the construction schedule.

B. Coordinate and attend weekly status meetings to review the overall progress and issues to be resolved throughout the course of construction. Prepare and distribute meeting agenda prior to and meeting notes after meetings in a format acceptable to the COR.

C. Scheduling: Prepare an overall construction schedule based on the results of the planning meetings with the COR. Prepare and issue updated schedules whenever there are modifications.

D. Perform weekly reviews, at a minimum, and provide a written report. Keep areas of work accessible and notify the COR of completed work released for review. A final punchlist shall be signed by the COR indicating all reviewed deficiencies have been corrected.

3.5 PROJECT CLOSEOUT AND RECORD DOCUMENTS

A. Provide a completed punch list and the necessary as-built documentation to the COR and a written form of acceptance for signature. Corrections must be completed before the COR will give acceptance.

B. The as-built documentation shall contain as-built drawings showing the layouts, rack elevations, and outlet numbering of all TRs and floors with all changes during the project detailed in the drawings; test results with all outlets showing PASS; and a binder with all materials and equipment manuals.

END OF SECTION 270500

SECTION 270526.10 - GROUNDING AND BONDING FOR SECURITY 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.

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SUMMARY

A. Section Includes:

1. Grounding conductors
2. Grounding connectors
3. Grounding busbars
4. Grounding rods
5. Grounding labeling

1.3 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.

B. BICSI: Building Industry Consulting Service International

C. TDMM: Telecommunications Distribution Methods Manual

D. TGB: Telecommunications grounding busbar.

E. TIA: Telecommunications Industry Association

F. TMGB: Telecommunications main grounding busbar.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For Security equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:

1. Ground rods.
2. Ground and roof rings.
3. BCT, TMGB, TGBs, and routing of their bonding conductors.

B. Qualification Data: For Installer, installation supervisor, and field inspector.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. Result of the ground-resistance test, measured at the point of BCT connection.
2. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

PART 2 - PRODUCTS

2.1 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 UL 467 for grounding and bonding materials and equipment.

C. Comply with TIA-607-B.

2.2 CONDUCTORS

A. Comply with UL 486A-486B.

B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: No. 6 AWG.

C. Cable Tray Grounding Jumper:

1. Not smaller than No. 6 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

C. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

D. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.

E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. Manufacturers:

1. Chatsworth Products.
2. Harger.
3. Panduit.

B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4 inch (100 mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches (6.3 by 50 mm) in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.

2. Mounting Hardware: Stand-off brackets that provide at least a 2 inch (50 mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

2.5 GROUND RODS

A. Utilize building ground.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with TIA-607-B.

3.3 APPLICATION

A. Conductors: Install stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36 inch (900 mm) intervals.
4. Install grounding and bonding conductors in 3/4 inch (21 mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.

    a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528.10 "Pathways for Security Systems, and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 AWG.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a Security equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pre-twist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Security Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 6 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for Security equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. Shielded Cable: Bond the shield of shielded cable to the TGB in Security rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.

J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

K. Access Floors: Bond all metal parts of access floors to the TGB.

L. Equipment Room Signal Reference Grid: Provide a low-impedance path between Security cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.

1. Install the conductors in grid pattern on 4 foot (1200 mm) centers, allowing bonding of one pedestal from each access floor tile.
2. Bond the TGB of the equipment room to the reference grid at two or more locations.
3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

M. Towers and Antennas:

1. Ground Ring: Buried at least 30 inches (760 mm) below grade and at least 24 inches (610 mm) from the base of the tower or mounting.
2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches (460 mm) below grade.
3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches (760 mm) below grade.
4. Bond metallic fences within 6 feet (1.8 m) of towers and antennas to the ground ring, buried at least 18 inches (460 mm) below grade.
5. Waveguides and Coaxial Cable:

a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.7 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TMGB(s) with "fs-TMGB," where "fs" is the Security space identifier for the space containing the TMGB.
2. Label TGB(s) with "fs-TGB," where "fs" is the Security space identifier for the space containing the TGB.
3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.

    a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

    a. With the grounding infrastructure completed and the Security system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.

C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 270526.10

DOCUMENT 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections includes:

1. Division 7 Sections, "Firestopping" and “Smoke Seals”.
2. 27 05 00 Common Work Results for Communications
3. 27 15 00 Telecommunications Horizontal Cabling

1.2 SUMMARY

A. Section Includes:

1. Related documents
2. Administrative requirements
3. Conduits and fittings
4. Boxes and enclosures
5. J-Hooks
6. Drop Wire
7. Re-Enterable Firestop Assemblies
8. Installations

1.3 ADMINISTRATIVE REQUIREMENTS

A. Methods of construction that are not specifically described or indicated in the Contract will be subject to the control and approval of the Owner or Owner’s Representative.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Erico/Caddy

B. Panduit

C. Hubbell

D. Carlon

E. Maxcell

F. STI EZPath

2.2 CONDUIT AND FITTINGS

A. General Requirements:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Minimum conduit size of 1 inch, but not less than the size shown on the drawings.
3. Indoors: Apply pathway products as specified below unless otherwise indicated:

    a. Exposed, not subject to severe physical damage: EMT.
    b. Concealed in Ceilings and Interior Walls and Partitions: EMT.
    c. Exposed and subject to severe physical damage: GRC. Example locations include, but not limited to the following:
        1) Loading dock.
        2) Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
        3) Mechanical rooms.
        4) Damp or Wet Locations

4. Minimum outlet conduit Size: 1-1/4-inch trade size for CAT 6A cables. Minimum size for optical-fiber cables is 1 inch.
5. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
6. Install surface pathways only where indicated on Drawings.
7. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

B. Electrical Metallic Tubing (EMT)

1. Only steel or malleable iron materials are acceptable.
2. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats.
3. Use gland and ring compression type couplings and connectors for conduit sizes 2 inches and smaller.
4. Use set screw type couplings with four set screws each for conduit sizes over 2 inches. Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.

C. Expansion Fittings: Match conduit type, rated for environmental conditions and including flexible external bonding jumper.

D. PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

E. Flexible steel conduit fittings:

1. Only steel or malleable iron materials are acceptable.
2. Clamp type, with insulated throat.

F. Rigid and IMC

1. Sealing bushings shall have galvanized malleable iron locking ring with molded neoprene sealing ring with predrilled holes to accommodate each individual conductor, stainless steel screws and washers, PVC-coated pressure discs, and factory-installed lay-in grounding conductor lugs.
2. Hub fittings shall be 2-piece, insulated throat, liquid tight type of steel or malleable construction.
3. Standard threaded couplings, locknuts, bushings, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
4. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
5. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
6. Erickson (union type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground.
7. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

G. Liquid tight flexible metal conduit fittings:

1. Only steel or malleable iron materials are acceptable.
2. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.

H. Rigid aluminum conduit fittings:

1. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
2. Locknuts and bushings: As specified for rigid steel and IMC conduit.

2.3 BOXES AND ENCLOSURES

A. General Requirements:

1. Provide boxes and enclosures designed and identified as defined in NFPA 70, for intended location and application. Minimum box size shall be 4-11/16" square x 2-1/8" deep. Utilize single or dual gang reducer rings as intended per telecom series drawings.
2. All equipment and associated hardware shall be fabricated and installed in accordance with the manufacturer's specified recommendations.
3. Box extensions used to accommodate building finishes shall be of same material as recessed box.
4. Cast-Metal access, pull and junction boxes: galvanized with cover.
5. Gangable (expandable) boxes are prohibited.
6. Hinged Cover Enclosures: Continuous-hinge cover with flush latch unless otherwise indicated.
7. Metal Enclosures: Steel: finished inside and out with manufacturer's standard enamel.
8. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and damp or wet locations.

B. Recessed and Poke-Through Floor Boxes:

1. Provide communications floor boxes that accommodate power, data and audio-video outlets as defined in the drawings with a stamped steel junction box for wire splices and connections.
2. The stamped steel junction box shall contain the necessary means to electrically ground the devices to the system ground. The mechanism shall be stamped steel construction that accepts both flexible and rigid conduit. This mechanism shall also accept ¾", 1", 1¼" or 2" trade size conduits. Telecom pathways shall always be 1¼" or larger.
3. The body shall maintain the fire rating of the floor slab.
4. Top Covers and Plates:

    a. Manufactured of die-cast aluminum alloy in powder-coated black finish and available in carpet and tile versions.
    b. The carpet covers shall be surface mounted and the tile covers shall be flush with the finished floor covering. The covers shall have spring loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.
    c. Provide covers with two (2) gaskets (one (1) for carpet and one (1) for tile) to go under the trim flange to maintain scrub water tightness.
    d. Poke through covers are secured to the flange and able to rotate greater than 180 degrees to reduce trip hazards and provide maximum amount of working space.

2.4 J-HOOK SUPPORTS

A. General Requirements: Suitable for interior applications within ceiling spaces for non-continuous, branch route supports of communications cabling.

1. Listings: Including, but not limited to Underwriters Laboratories Inc. (UL) Standard 2043, for use in air handling spaces.

B. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified:

1. Erico, Inc. “CableCat” CAT2, CAT12, CAT32 J-hook series.
2. Panduit Corp., “J-Mod” cable support system, JMJH2-X and JMJH2W-X series.
3. Cooper B-Line Inc., BCH12, BCH21, BCH32 series hooks.
4. Or approved equal.

C. Product and Installation Responsibility lies with the cable installer.

2.5 DROP WIRE

A. Application: Suitable for indoor installation within ceiling space into structure above (e.g., slab and/or deck) for the support of telecommunications cable hanger support devices.

B. Listings: UL 2043, for use in air handling spaces.

C. Assembly shall be equipped with ceiling clip, pre-mounted fastening pin, plastic washer, and pre-tied wire.

Fastening pin shall be 7/8”.

Wire shall be 12 gauge.

D. Manufacturer, or equal:

Hilti #CC27 X-AL-H22P8T xx ft PT; drop wire assembly, xx foot wire – where “xx” is the length.

2.6 CONDUIT RADIUS WATERFALL

A. Application: Suitable for indoor installation within plenum ceiling spaces. Attaches to 4” trade size sleeves or conduits to facilitate weight distribution of the cables’ bend radius into tray systems that can not be transitionally aligned within a 24” or greater elevation variance.

B. Listings: UL 2043, for use in air handling spaces.

C. Assembly equipped with clam-shell opening and thumb screws for attachment to 4” sleeves and conduits.

D. Baseline Manufacturer, or equal:

1. Panduit # CWF4: 4” Conduit Waterfall

2.7 RE-ENTERABLE FIRESTOP ASSEMBLIES

A. Provide fire-rated cable pathway devices for use in fire-rated construction for ALL new and retrofit penetrations are needed for low-voltage, voice, data, video cabling and optical fiber race-

ways where frequent moves, adds and changes may occur. Pathways required for low voltage communications cabling will be based on the quantity of cables removed during demolition phase of work.

B. Such devices shall:

1. Meet the hourly fire-rating of fire rated wall and or floor penetrated.
2. Be tested for the surrounding construction and cable types involved.
3. Have UL Systems permitting cable loads from; "Zero to 100% Visual Fill" thus eliminating the need for fill-ratio calculations to be made by cable technicians to ensure cable load is within maximum allowed by UL System.
4. Be "Maintenance-Free", having a corresponding Evaluation Services Report from a Nationally Recognized Third Party Laboratory (NRTL). Maintenance-Free is defined as; No action required by cabling technician to open and/or close pathway for cable moves, adds or changes, such as, but not limited to:

    a. Opening or closing of doors.
    b. Spinning rings to open or close fabric liner.
    c. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
    d. Evaluation Services Report (ESR) from an accredited NRTL certifying compliance with this definition of "Maintenance-Free" and all relevant codes and standards.

5. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
6. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.
7. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.

C. Non-rated cable pathway devices shall be used in non-fire-rated construction for all low-voltage, video, data and voice cabling, optical fiber raceways and certain high-voltage cabling where frequent cable moves, adds and changes may occur. Pathways required for high voltage cabling will be detailed on the prints. Such devices shall:

1. Limit the movement of smoke and sound of wall and or floor penetrated.
2. Restore the STC Rating of the penetrated assembly.
3. Provide L Ratings of greater than 1 CFM when empty and greater than 2.5 CFM at all other loading up to 100 percent.
4. Accommodate cable loads from; "Zero to 100% Visual Fill."
5. Not have inner fabric liner that tightens around and compresses cables tightly together encouraging potential cable damage or interference.

6. Be “Maintenance-Free”, maintenance-free is defined as; No action required by cabling technician to open and/or close pathway for cable moves, adds or changes, such as, but not limited to:

    a. Opening or closing of doors.
    b. Spinning rings to open or close fabric liner.
    c. Removal and or replacement of any material such as, but not limited to, firestop caulk, putty, pillows, bags, foam muffins, foam, foam plugs, foam blocks, or foam closures of any sort.
    d. Furnish letter from manufacturer certifying compliance with this definition of “Zero-Maintenance”.

7. Pathways shall be engineered such that two or more devices may be ganged together for larger cable capacities.
8. Pathways shall be engineered to be re-enterable so they can be retrofitted and removed from around existing cables without cutting and re-splicing them.
9. Affix adhesive wall label immediately adjacent to devices to communicate to future cable technicians, authorities having jurisdiction and others the manufacturer of the device and the corresponding UL System number installed.

D. As an alternate to using a fire-rated or non-rated cable pathway device for a single or tow low voltage cables (up to an aggregate cross sectional area of 0.52 in. (14mm) O.D.) penetrating one or two-hour, gypsum board/stud wall assemblies or non-rated assemblies, either as a through-penetration or as a membrane-penetration, a fire-rated cable grommet may be substituted. The product shall consist of a molded, two-piece, plenum-rated grommet having a foam fire and smoke sealing membrane that conforms to the outside diameter of the individual cable. The grommet product shall be capable of locking into place to secure the cable penetration within the wall assembly. The grommet shall be UL Classified and tested to the requirements of ASTM E814 (UL 1479) and CAN/ULC S115.

E. Where non-mechanical pathways must be utilized, such as sealing (caulking) around single or grouped conduits, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction. Provide letter from manufacturer certifying compliance with this section.

F. Cable pathway shall replace conduit sleeves in walls and floors, and the following;

1. When installed individually in floors, devices shall pass through core-drilled or pre-formed opening utilizing tested floor plates.
2. When multiple units are ganged in floors, devices shall be anchored by means of a tested grid.
2. When installed individually in walls, devices shall pass through core drilled opening utilizing tested wall plates or integrated flanges.
3. When multiple units are ganged in walls, devices shall be anchored by means of a tested adjustable gang bracket.

G. Cable tray shall terminate at each barrier and resume on the other side such that cables pass independently through devices. Cable tray shall be properly supported on each side of the barrier.

1. MANUFACTURERS

a. Acceptable Manufacturer: Specified Technologies Inc., 210 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: techserv@stifirestop.com, Website: www.stifirestop.com.
b. Substitutions: Not permitted. No known equal.
c. Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

H. MATERIALS

1. General: Use only products that have been tested for specific fire resistance rated construction conditions or acoustical and smoke related requirements conforming to construction assembly type, penetrating item type, annular space requirements, and rating involved for each separate instance.
2. Firestop Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:

1) Specified Technologies Inc. (STI) SpecSeal Series SSS Sealant.
2) Specified Technologies Inc. (STI) SpecSeal Series LCI Sealant.

3. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:

1) Specified Technologies Inc. (STI) SpecSeal Series SSP Putty.

4. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag, the following products are acceptable:

1) Specified Technologies Inc. (STI) SpecSeal Series SSB Pillows.

5. Fire-Rated Cable Grommet: Molded, two-piece grommet with an integral fire and smoke sealing foam membrane for sealing individual cable penetrations through framed wall assemblies. Grommet snaps together around cable and locks tightly into the wall.

1) Specified Technologies Inc. (STI) EZ-Firestop Grommets.

6. Fire-Rated Cable Pathways: Device modules comprised of steel pathway with self-adjusting intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:

1) Specified Technologies Inc. (STI) EZ-PATH Fire Rated Pathway.

7. Smoke and Acoustical Pathways: Device module comprised of a nonmetallic pathway with integral self-adjusting smoke and sound sealing system for cable penetrations through non-fire-resistance rated wall or floor assemblies, the following products are acceptable:

    1) Specified Technologies Inc. (STI) EZ-PATH Smoke & Acoustical Pathway.

8. Protective Wrap: Endothermic Wrap incorporating foil scrim evaluated for protection of cable pathways, liquid fuel lines, as well as in through-penetration and membrane-penetration firestopping. Testing to incorporate protection of Electrical Metallic Tubing (EMT), Rigid Metallic Conduit (RMC), and Cable Trays. Wrap to have a maximum weight of no greater than 1.4 lbs/ft^2 and allow for the use of steel tie wire when installed around piping, conduits, and/or cable trays. The following products are acceptable:

    1) Specified Technologies, Inc. (STI) E-Wrap™ Endothermic Wrap

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Requirements

1. Examine surfaces and spaces for compliance with installation tolerances and other conditions affecting performance installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the Owner's Representative.
3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Notify the Owner's Representative of conditions that may adversely affect the installation, subsequent use, or cause the pathway (or circuits to be subsequently installed in the pathway) to not comply with ANSI/TIA/EIA standards.
5. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
6. Complete pathway installation before starting cable installation.
7. Arrange stub-ups so curved portions of bends are not visible above finished slab.
8. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius elbows for all optical-fiber cables.
9. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
10. Clearance requirements for cable tray accessibility:

a. Maintain a clearance of 6” between top of cable tray and ceiling structure or other equipment or raceway.
b. Maintain a clearance of 8” between at least one side of cable tray and nearby objects.
c. Maintain a clearance of 6” between bottom of cable tray and ceiling grid or other equipment or raceway.

11. Clearance requirements from sources of electromagnetic interference (EMI):

a. Maintain a clearance of 5” or more from fluorescent lighting.
b. Maintain a clearance of 12” or more from conduit and cables used for electrical power distribution.
c. Maintain a clearance of 48” or more from motors or transformers.
d. Pathways shall cross perpendicularly to electrical power cables or conduits.

12. J-Hooks may be used to support horizontal branch route cables only between cable tray and outlet conduits. All support HW shall be spaced at 4-5ft span distances.

B. Fire stopping

1. Where re-enterable firestop systems have not been provided, install UL listed mechanical firestop assemblies for penetrations through rated walls, floors and partitions to restore original rating in accordance with manufacturer’s instructions and as approved for use by the Authority having Jurisdiction.

C. Conduit Supports

1. Support multiple conduit runs with trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 pounds.
2. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T bars, angle supports, and similar items.
3. Fasteners and Supports in Solid Masonry and Concrete:

a. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
b. Existing Construction:
- Steel expansion anchors not less than 1/4 inch bolt size and not less than 28 mm (1 1/8 inch) embedment.
- Power set fasteners not less than 1/4 inch diameter with depth of penetration not less than 3 inches.
- Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

4. Hollow Masonry: Toggle bolts are permitted.
5. Bolts supported only by plaster or gypsum wallboard are not acceptable.

6. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
7. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
8. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

D. Exposed Work

1. Exposed conduit is only permitted as indicated on the drawings or as approved through submittal review process.
2. Align and run conduit parallel or perpendicular to the building lines.

E. Furred or Suspended Ceilings and in Walls:

1. Connect fixtures to conduit runs with maximum 1800 mm (six feet) of flexible metal conduit extending from a junction box to the fixture.

F. Pathways Embedded in Concrete:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Owner for each specific location.
5. Conduit: Rigid steel, IMC or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
6. Align and run conduit in direct lines.
7. Install conduit through concrete beams only when the following occurs:

    a. Where shown on the structural drawings.
    b. As approved by the Owner Representative prior to construction, and after submittal of drawing showing location, size, and position of each penetration.

8. Installation of conduit in concrete that is less than 3 inches thick is prohibited.

    a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
    b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
    c. Install conduits approximately in the center of the slab so that there will be a minimum of 3/4 inch of concrete around the conduits.

9. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

H. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

I. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

J. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

K. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

L. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

M. Surface Pathways:

1. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions.

N. Pathways for Non-Armored Optical-Fiber Cable: Install pathways between pull-boxes, metal and nonmetallic, rigid and flexible, as follows:

1. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

O. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

P. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

Q. Expansion-Joint Fittings:

1. Conduits 75 mm (3 inches) and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
2. Provide conduits smaller than 3 inches with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 5 inch vertical drop midway between the ends. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 15 inches and larger conduits are acceptable.
3. Seismic Areas: In seismic areas, provide conduits rigidly secured to the building structure on opposite sides of a building expansion joint with junction boxes on both sides of the joint. Connect conduits to junction boxes with 15 inches of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed.
4. 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: 55 deg F (86 deg C) temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

5. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
6. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
7. 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.

R. Mount boxes at heights indicated on drawings. Install boxes with height measured to center of box unless otherwise indicated.

S. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a rain-tight connection between the box and cover plate or supported equipment and box.

T. Horizontally separate boxes mounted on opposite sides of a wall so they are not in the same vertical channel.

U. 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.

V. Cable Hangers

1. Hanger routes are not show, but are implied to be installed parallel to, and at right angles to the building support structure.

2. Install hangers in accordance with recognized industry practices. Ensure that the installed system complies with requirements of the NEC, and applicable portions of NFPA 70B and NECA/BICSI "Standards of Installation" pertaining to general installation practices and separation requirements of the subsequent installed cabling from high-voltage lines, motors, and other sources of EMI/RFI.

3. Plan all hanger products in accordance with recognized industry practices and manufactures statements for max capacity cable bundle sizes. Ensure all J-Hook or similar supports are appropriately sized to no more than 75% of the Day-1 Max Capacity intended for bulk cable distributions between tray systems and work area outlet receptacles. The intent is to provide a minimum 25% spare capacity for future growth, Move/Add/Change work, and/or minor capacities to accommodate parallel paths for other 3rd party building utility cable service provider (CATV) drop cable installs being co-routed with voice/data. Any J-Hooks or similar distribution supports found to be undersized during periodic walkthrough reviews of contractor's work will be rejected.

4. Provide dedicated supports at typical forty eight inch (48") spans; not to exceed maximum sixty inch (60") spans, on any given route. Supports shall consist of #12 wire or ¼" threaded rod depending on size and capacity of cable hanger. Suspend wire or rod using components appropriate for the structure – e.g., powder-actuated clip fastener for wire; beam flange clip or angled flange clip for either wire or rod; or an embedded anchor for the threaded rod. Do not share wire or rod supports with other trade work. Do not support the hanger on ceiling grid support wires. Do not support the hanger from ductwork, piping, light fixtures or any other equipment hangers.

5. Install hangers so that finished heights are at least six inches (6") from light fixtures or other EMI/RFI sources. Install hanger supports between six inches (6") and eighteen inches (18") above ceiling grid system. Vary the elevation of all route end-points to ensure smooth cable ingress/egress transitions are made through sleeves and conduits, and into cable tray systems.

W. Protection

1. Protect coatings, finishes, and cabinets from damage or deterioration.

    a. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
    b. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF DOCUMENT - 270528

SECTION 270528.10 - PATHWAYS FOR SECURITY 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.

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Metallic surface pathways.
7. Nonmetallic surface pathways.
8. Recessed Poke-thru
9. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. BICSI: Building Industry Consulting Service International

C. GRC: Galvanized rigid conduit.

D. IMC: Intermediate metal conduit.

E. RTRC: Reinforced thermosetting resin conduit.

F. TIA: Telecommunications Industry Association

1.4 ACTION SUBMITTALS

A. Product data for the following:

1. Surface pathways
2. Wireways and fittings.
3. Tele-power poles.
4. Boxes, enclosures, and cabinets.
5. Underground handholes and boxes.

B. Shop Drawings: For custom enclosures and cabinets and custom underground handholes and boxes. Include plans, elevations, sections, and attachment details.

1.5 INFORMATION SUBMITTALS

A. Seismic Qualification Data: Seismic rating for all pathway racks, enclosures, cabinets, equipment racks, and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated IMC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
5. Bushings: Required for all terminating conduit ends.

I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

B. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

C. RNC: Type EPC-40-PVC or Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Rigid HDPE: Comply with UL 651A.

E. Continuous HDPE: Comply with UL 651A.

F. RTRC: Comply with UL 2515A and NEMA TC 14.

G. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 OPTICAL FIBER CABLE RIGID PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for riser installation unless otherwise indicated.

B. Conduit Innerduct:

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

2.4 OPTICAL FIBER CABLE FABRIC PATHWAYS AND FITTINGS

A. Description: 3” single or multi cell polyester/nylon textile innerduct containing 1250 lb polyester flat woven pull tape, approved for riser installation unless otherwise indicated.

B. Manufacturer: MaxCell Group.

C. Fittings: Compression-type conduit plugs with locking nuts and inflation-type termination bags.

2.5 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.

B. General Requirements for Metal Wireways and Auxiliary Gutters:

1. Comply with UL 870 and NEMA 250, Type 1, Type 3R, Type 4, Type 12, unless otherwise indicated, and sized according to NFPA 70.
2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
3. Comply with TIA-569-D.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.6 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

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. Solvents and Adhesives: As recommended by conduit manufacturer.

2.7 SURFACE METAL PATHWAYS

A. Description: Galvanized steel with snap-on covers, complying with UL 5.

B. Finish: Manufacturer's standard enamel finish in color selected by Architect. Prime coated, ready for field painting.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

2.8 SURFACE NONMETALLIC PATHWAYS

A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.

B. Finish: Texture and color selected by Architect.

C. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

E. Comply with TIA-569-D.

2.9 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.
2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Device Box Dimensions: **4 inches** square by **2-1/8 inches** deep (**100 mm** square by **60 mm** deep) and **4 inches** by **2-1/8 inches** by **2-1/8 inches** deep (**100 mm** by **60 mm** by **60 mm** deep).
5. Gangable boxes are allowed.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: adjustable.
3. Shape: Rectangular.
4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. 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.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures:

    a. Material: Fiberglass.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

K. Cabinets:

1. NEMA 250, Type per installation location, with removable interior panel and removable front, finished inside and out with manufacturer's standard.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: IMC.
2. Concealed Conduit, Aboveground: IMC.
3. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: IMC. Pathway locations include the following:
    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums
4. Concealed in Ceilings and Interior Walls and Partitions: EMT, and innerduct.
5. Damp or Wet Locations: IMC.
6. Pathways for Optical-Fiber and Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway, Plenum-type, communications-cable pathway, EMT.
7. Pathways for Optical-Fiber and Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway Riser-type, communications-cable pathway, EMT.
8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway, Riser-type, optical-fiber-cable pathway, Plenum-type, optical-fiber-cable pathway, General-use, communications-cable pathway, Riser-type, communications-cable pathway, Plenum-type, communications-cable pathway, EMT.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic units in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch (21-mm) trade size for copper and aluminum cables, and 1 inch (25 mm) for optical-fiber cables.

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealants recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.3 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270544.10 "Sleeves and Sleeve Seals for Security Pathways and Cabling" for sleeves and sleeve seals for communications.

E. Label all security conduits with blue marking band or blue paint every 10 feet (9000 mm). Paint security junction box covers with paint manufactured by Benjamin Moore #791, Duron 5085A (Americana) or approved equivalent.

F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Complete pathway installation before starting conductor installation.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. Pathways 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 pathways to reinforcement at maximum 10 foot (3 m) intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
3. Arrange pathways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from nonmetallic conduit and fittings to IMC and fittings before rising above floor.

M. Stub-ups to Above Recessed Ceilings and Conduit Terminations at Cable Trays:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

S. Cut conduit perpendicular to the length. For conduits of 2 inch (50 mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

T. Install pull wires in empty pathways. 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. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

U. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings (Telecommunications Only).
2. Install surface pathway with a minimum 2 inch (50-mm) radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

V. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. ¾ Inch (21 mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
2. 1 Inch (25 mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

W. Fabric Pathways for Optical-Fiber-Cable:

1. Install per manufacturer’s recommendations and guidelines.

2. Provide textile innerduct in conduit and wire ways, and place textile innerduct within and under cable trays using continuous, unspliced lengths of textile innerduct between maintenance holes, pull boxes, and/or termination points as indicated on the Drawings.
3. Do not fasten textile innerduct to steam, water, or other piping, ductwork, mechanical equipment, electrical equipment, electrical raceways, or wires.
4. Cable Tray and Runway Installation: Cut incisions every 24 inches (61 cm) into the edge of the textile innerduct and cable wrap to one side of vertical ladder rack or horizontal ladder-type cable tray at each incision.

X. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

Y. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

Z. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

AA. 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). Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 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 deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115

mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

EE. 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.

FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

GG. Set metal floor boxes level and flush with finished floor surface.

HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544.10 "Sleeves and Sleeve Seals for Security Pathways and Cabling."

3.5 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping." Do not begin installation work until certificates of conformance or compliance, manufacturer's catalog data, and details for fire stopping of penetrations and joint systems showing compliance with the

appropriate UL Design Number are approved by the Office of Safety Health and Environmental Management Fire Protection Engineer.

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528.10

SECTION 270536.10 - CABLE TRAYS FOR SECURITY 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.

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SUMMARY

A. Section Includes:

1. Ladder cable tray.
2. Wire-mesh cable tray.
3. Cable tray accessories.
4. Warning signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cable tray.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.

1. Temperature Change: 120 deg F (67 deg C), ambient.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Acceptable Manufacturers:

1. Chatsworth
2. Commscope
3. Legrand
4. Snake Tray

B. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

C. Sizes and Configurations: See Drawings for specific requirements for types, sizes, and configurations.

D. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAY

A. Description:

1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
2. Width: [**12 inches (300 mm)**] [**18 inches (450 mm)**] unless otherwise indicated on Drawings.
3. Rung Spacing: 12 inches (300 mm) o.c.
4. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
5. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.
6. No portion of the rungs shall protrude below the bottom plane of side rails.
7. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200 lb (90 kg) concentrated load, when tested according to NEMA VE 1.
8. UL classified for suitability as an equipment grounding conductor.
9. Splicing Assemblies: Bolted type using serrated flange locknuts.
10. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

11. Materials and Finishes: Steel, black powder-coat finish.

2.4 WIRE-MESH CABLE TRAY (BASKET TRAY)

A. Description:

1. Configuration: Steel wire mesh, complying with NEMA VE 1.
2. Width: **8 inches (200 mm)** unless otherwise indicated on Drawings.
3. Minimum Usable Load Depth: **4 inches (100 mm)**.
4. Straight Section Lengths: 10 feet (3.0 m), except where shorter lengths are required to facilitate tray assembly.
5. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200 lb (90 kg) concentrated load, when tested according to NEMA VE 1.
6. Class Designation: Comply with NEMA VE 1.
7. Splicing Assemblies: Bolted type using serrated flange locknuts.
8. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
9. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
10. Materials and Finish: Steel. Galvanized before fabrication (pre-galvanized) or painted black with powder coat paint.

2.5 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, splices, and other fittings as required, of same materials and finishes as cable tray.

B. Splices that electrically bond cable tray sections and fittings together.

C. Divider: Same materials and finishes as for cable tray, installed to separate cable tray into multiple pathways. Dividers to be same height as sidewalls of cable tray.

D. Liner: Solid, black polymer liner for the bottom and sides of the wire mesh cable tray. Size liner to match the width of the cable tray, rated UL 94V-0, non-hydroscopic with moisture absorption <0.1% and rated for temperatures up to 239 deg F (115 deg C).

E. Cable tray supports and connectors, including bonding jumpers and splices, as recommended by cable tray manufacturer.

F. Miscellaneous accessories: Conduit attachment bracket, radius drop,

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA VE 2 and cable tray manufacturer’s recommendations.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, dividers, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, liners, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join cable tray with splice plates that maintain electrical bond between sections; use four square neck-carriage bolts and locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints, where required.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb (90 kg).

H. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in center support, trapeze, or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

L. Support center support hangers and trapeze hangers for wire-basket trays with threaded rods, sized based on potential maximum tray loading.

M. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

N. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.

O. Make changes in direction and elevation using manufacturer's recommended fittings.

P. Make cable tray connections using manufacturer's recommended fittings.

Q. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

R. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

S. Install cable trays with enough workspace to permit access for installing cables.

T. Install barriers/dividers to separate cables of different systems and type. Install dividers to separate pathways within cable tray for optical fiber cables, and copper communications cables.

U. Install warning signs in visible locations on or near cable trays after cable tray installation.

V. Flattened, dented, or deformed cable tray is not permitted. Remove and replace the damaged cable tray with new undamaged material. Assure cable tray installation does not encroach into the ceiling height head room, walkways, or doorways.

W. Verify that there are no intruding items such as pipes, hangers, or other equipment in the pathway.

3.3 CLEARANCES

A. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

B. Clearance requirements for accessibility:

1. Maintain a clearance of 6 inches (152 mm) between top of cable tray and ceiling structure or other equipment or raceway.
2. Maintain a clearance of 8 inches (203 mm) between at least one side of cable tray and nearby objects.
3. Maintain a clearance of 6 inches (152 mm) between bottom of cable tray and ceiling grid or other equipment or raceway.

C. Clearance requirements from sources of electromagnetic interference (EMI):

1. Maintain a clearance of 5 inches (127 mm) or more from fluorescent lighting.
2. Maintain a clearance of 12 inches (305 mm) or more from conduit and cables used for electrical power distribution.
3. Maintain a clearance of 48 inches (1219 mm) or more from motors or transformers.
4. Pathways shall cross perpendicularly to electrical power cables or conduits.
5. Maintain 6 inches (152 mm) cable separation between unlike signal types.

3.4 EXPOSED WORK

A. Exposed pathway is only permitted as indicated on the drawings or as approved through submittal review process.

B. Install black polymer liner within wire-basket cable tray in all exposed locations, unless otherwise indicated. Cables within these cable trays should not be visible from finished floor level.

3.5 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems."

B. Cable trays shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72 inch (1800 mm) intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.6 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

E. In existing construction, remove inactive or dead cables from cable trays.

3.7 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.8 FIELD QUALITY CONTROL

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.

3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and re-torque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.9 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping." Do not begin installation work until certificates of conformance or compliance, manufacturer's catalog data, and details for fire stopping of penetrations and joint systems showing compliance with the appropriate UL Design Number are approved by the Office of Safety Health and Environmental Management Fire Protection Engineer.

3.10 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 270536.10

SECTION 270544 - SLEEVES AND SLOTS, AND SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Slots and Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors
2. Slots and Sleeve-seal systems
3. Sleeve and Slot-seal fittings
4. Grout
5. Silicone sealants

1.2 RELATED DOCUMENTS

A. 270500 Common Work Results for Communications

1.3 REFERENCE STANDARDS

A. ASTM D1785 - 12 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

B. ASTM A53 / A53M – 12 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

C. ASTM C1107 / C1107M – 11 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)

D. Provide UL listed mechanical firestop assemblies for penetrations through rated walls, floors and partitions to restore original rating approved for use by the Authority having Jurisdiction.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop unless otherwise indicated.

B. Position sleeves adjacent to a vertical wall. Sleeves must not obstruct wall-terminating space. That is they should not be located directly above or below wall space that is used for termination fields below

C. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

D. Extend a minimum of 1" above the floor level, 2" past wall surface.

E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 SLOTS

A. Position slots adjacent to a vertical wall. Slots must not obstruct wall-terminating space. That is they should not be located directly above or below wall space that is used for termination fields.

B. Provide a minimum of 1" high curb

C. The minimum slot size is 6" by 10". The location and configuration of the slot(s) shall be approved by a structural engineer.

2.3 SLEEVE, SLOT-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, water stop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber water stop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 3 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position water stop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION - 270544

SECTION 270544.10 - SLEEVES AND SLEEVE SEALS FOR SECURITY PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 “Common Work Results for Electronic Security”.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239 inch (0.6 mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon or Stainless steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 SLEEVE INSTALLATION FOR NON-FIRE-RATED PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

    a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4 inch (6.4 mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1 inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1 inch (25 mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical

sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position water-stop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 270544.10

SECTION 271116.10 - SECURITY CABINETS, RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 “Common Work Results for Electronic Security”.

1.2 SUMMARY

A. Section Includes:

1. 19-inch equipment racks.
2. 19-inch freestanding and wall-mounted equipment cabinets.
3. Power strips.
4. Grounding.
5. Labeling.

1.3 DEFINITIONS

A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.

B. BICSI: Building Industry Consulting Service International.

C. LAN: Local area network.

D. RCDD: Registered communications distribution designer.

E. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.

F. TDMM: Telecommunications Distribution Methods Manual

G. TGB: Telecommunications grounding bus bar.

H. TIA: Telecommunications Industry Association

I. TMGB: Telecommunications main grounding bus bar.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, certifications, standards compliance, and furnished specialties and accessories.

B. Shop Drawings: For communications racks, frames, and enclosures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of TGB and its mounting detail showing standoff insulators and wall-mounting brackets.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
2. Installation Supervision: A BICSI Installer 2 (Copper and Fiber, as applicable) shall perform all installation work with a BICIS Technician providing direct supervision of the installation work. Technician shall be present at all times when performing Work of this Section at Project site.
3. Field Inspector: Currently registered by BICSI as RCDD to perform on-site inspection.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 <Insert Seismic zone>.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

B. UL listed.

C. RoHS compliant.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backboards specified in Section 061000 "Rough Carpentry."

B. Backboard Paint: Pre-painted white with fire-retardant paint. Paint all six sides with two coats of fire resistant paint. Do not paint over manufacturer's label.

2.3 FLOOR MOUNTED 4-POST CABINET – 42 INCH DEEP

A. Acceptable Manufacturers

1. Middle Atlantic

B. Middle Atlantic SNE24D-4542-P1-WT or approved equivalent.

C. Minimum Required Features and Specifications

1. 24 inch wide x 42 inch deep x 84-3/4 inch high
2. 45 rack units
3. Front and rear cage-nut rack rails
4. Configured for passive front-to-back cooling
5. 70% open front door and 70% open area split rear door
6. Solid top with brush cable pass-through
7. Gangable

8. White powder coat finish
9. Side panels
10. Casters with leveling feet

D. Additional Required Options / Parts

1. Two (2) Tripp Lite PDUMV30HVNETLX power strips per rack or approved equivalent
   a. 30 Amp power strip.
   b. Power strip shall be 70 inch (1778 mm) long with 24 plug-lock inserts.
   c. Have 120 inch (3048 mm) cord with NEMA L6-30P, 30 Amp twistlock plug
   d. 30 Amp input shall feed two 20 Amp circuit breakers
   e. Mount using included rack mounting hardware
   f. UL Listed in the US and Canada
   g. 2-year limited warranty
2. One (1) Lowell RPLF Rackmount Light per rack or approved equivalent
   a. One (1) rack unit high
   b. LED light bar containing a total of five white and amber lights controlled by a push button on/off switch
   c. 525 lumens (total)
   d. Beam angle: 56 degrees x 12 degrees
   e. Life span 35000 hours
   f. Black powder epoxy finish
3. One (1) Middle Atlantic RM-KB-LCD17KVMHD rackmount console or approved equivalent
   a. EIA compliant 19 inch (483 mm) rackmount LCD monitor, keypad with integrated touchpad
   b. One (1) rack unit high
   c. High definition (1080P), 17 inch (432 mm) widescreen (16:9) display, keyboard and touchpad
   d. IP-enabled for remote monitoring and management
   e. Dual rail design allows monitor to reside in open position for system monitoring while keyboard is recessed
   f. ETL listed in the US and Canada
4. One (1) Middle Atlantic BB-44-1 copper bus bar per rack or approved equivalent
   a. 1/8 inch (3 mm) thick, 1 inch (25.4 mm) wide copper
   b. Threaded 10-33
   c. Supplied with mounting hardware; nylon isolation washers, nuts and bolts
   d. 44 RU
5. Two (2) Middle Atlantic LACE-WB6-42 wire grid lace per rack or approved equivalent
   a. Vertical 6 inch (152 mm) wide steel lace
   b. 42 RU
   c. Middle Atlantic TW12 straps or approved equivalent, as required
6. Power cords
   a. Provide all power cords to plug devices into the power strips

2.4 FLOOR MOUNTED 2-POST RACK

A. Acceptable Manufacturers

1. Middle Atlantic

B. Middle Atlantic RLA19-1245B or approved equivalent.

C. Minimum Required Features and Specifications

1. 12-24 threaded front and rear, with numbered spaces
2. 45 RU
3. Heavy duty base includes holes for securing to floor
4. Black powder coat finish

D. Additional Required Options / Parts

1. Two (2) Middle Atlantic RLA-CC cable duct or approved equivalent
2. One (1) Middle Atlantic BB-44-1 copper bus bar or approved equivalent
   a. 1/8 inch (3 mm) thick, 1 inch (25.4 mm) wide copper
   b. Threaded 10-33
   c. Supplied with mounting hardware; nylon isolation washers, nuts and bolts
   d. 44 RU

2.5 WALL MOUNTED RACKS

A. Acceptable Manufacturers

1. Middle Atlantic

B. Middle Atlantic DWR-12-22 and DWR-12-26 or approved equivalent.

C. Minimum Required Features and Specifications

1. Provide 12 rack units
2. Tool-Free Quick-Mount™ system enables one-person installation.
3. Center section and back pan shall be 16-gauge steel, phosphate pre-treated and finished in a black textured powder coat.
4. Rack rail shall be constructed of 11-gauge steel with tapped 10-32 mounting holes in universal EIA spacing with black e-coat finish and marked rack spaces.
5. Rack shall be constructed to swing open for component cabling access, center section shall pivot for either left or right opening.
6. Rack shall have a rear knockout panel with 1/2, 3/4, 1, 1-1/2, 2, and 3 inch (13, 19, 25.4, 38, 51, and 76 mm) electrical knockouts installed in base, and a rear knockout panel with 1/2, 3/4, 1, 1-1/2, 2, and 3 inch (13, 19, 25.4, 38, 51, and 76 mm) electrical knockouts, four Decora® cutouts, and BNC knockouts for UHF/VHF antennas installed in top.
7. Large laser knockout on back pan shall have a 12.5 x 12.5 inch (318 x 318 mm) cutout for electrical pull-box.
8. Fan knockouts on top and bottom shall allow for installation of up to four 4.5 inch (114 mm) fans.
9. Rack shall have 2 inch (51 mm) knockouts, 4 inch (76 mm) knockouts for Wiremold 4000®

10. Series raceways and knockouts for UCP Series universal connector panels on the side.
11. Top, bottom, and sides shall feature vertical vent pattern.
12. Satisfy the 2007 & 2010 CBC; 2006, 2009 & 2012 IBC; ASCE 7-05 (2005 Edition) & ASCE 7-10 (2010 Edition) and the 2006 & 2009 editions of NFPA 5000 for use in areas of high seismicity, Seismic Use Group III, Zone 4 or Seismic Design Category (SDC) "D" with lateral force requirements for protecting 140 lbs. of essential equipment in locations with the highest level of seismicity and top floor or rooftop installations with an Importance factor (Ip) of 1.5 when used with DWRSR-ZL Latch.
13. UL Listed in the US and Canada.
14. GREENGUARD Gold Certified.
15. Comply with the requirements RoHS EU Directive 2002 / 95 / EC. Manufactured by an ISO 9001 and ISO 14001 registered company.
16. Warrantied to be free from defects in materials or workmanship under normal use and conditions for the lifetime of the rack.

D. Additional Required Options / Parts

1. One (1) Tripp Lite PDUMNH20HV power distribution unit (PDU) or approved equivalent
   a. One (1) rack unit high PDU
   b. Horizontal rackmount installation using included rack mounting hardware
   c. Single-phase monitored
   d. Reports voltage, frequency, and load via Ethernet
   e. Visual current meter
   f. C20 inlet, 8ft (2.4m) C20 to L6-20P cable
   g. 8 C13 outlets
   h. TAA Compliant
   i. 2-year limited warranty
2. One (1) Lowell RPLF Rackmount Light per rack or approved equivalent
   a. One (1) rack unit high
   b. LED light bar containing a total of five white and amber lights controlled by a push button on/off switch
   c. 525 lumens (total)
   d. Beam angle: 56 degrees x 12 degrees
   e. Life span 35000 hours
   f. Black powder epoxy finish
3. One (1) Middle Atlantic BB-12 copper bus bar or approved equivalent
   a. 1/8 inch (3 mm) thick, 1 inch (25.4 mm) wide copper
   b. Threaded 10-33
   c. Supplied with mounting hardware; nylon isolation washers, nuts and bolts
   d. 12 rack units

E. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.

F. Horizontal Cable Management

1. Middle Atlantic HCM-1D and 2D, or approved equivalent

2. D-ring style, welded steel.
3. Baked-polyester powder coat finish.
4. Refer to Drawings for quantity and size; provide (1) per switch, and (1) per patch panel, minimum.

2.6 LABELING

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

B. Comply with NECA/BICSI 607.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout of communications equipment spaces.

C. Comply with BICSI ITSIMM for installation of communications equipment spaces.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.

1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of communications equipment.
4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

G. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection" Ch.

3.3 IDENTIFICATION

A. Coordinate system components, wiring, and cabling complying with TIA-606-B.

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA-606-B.

D. Labels shall be machine printed. Type shall be 3/16 inch (5 mm) in height.

END OF SECTION 271116.10

SECTION 271300.10 - SECURITY BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 “Common Work Results for Electronic Security”.

1.2 SUMMARY

A. Section Includes:

1. 850 nanometer laser-optimized 50/125 micrometer multimode (OM4), indoor tight buffer, optical fiber cable.
2. 9/125 micrometer single-mode (OS2), Riser Rated, Indoor-Outdoor Optical Fiber Cable, 6-Strand, loose tube, double-jacket, armored
3. 9/125 micrometer single-mode (OS2), 50/125 micrometer multimode (OM4) hybrid, indoor tight buffer, optical cable.
4. Optical fiber cable connecting hardware, patch panels, and cross-connects.
5. Cabling identification products.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. ICEA: Insulated Cable Engineers Association

D. ITSIMM: Information Technology Systems Installation Methods Manual

E. RCDD: Registered Communications Distribution Designer.

F. TIA: Telecommunications Industry Association

1.4 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

A. Optical fiber backbone cabling system shall provide interconnections between communications rooms, main terminal space, and entrance facilities in the communications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics including the following:

    a. Backbone Riser Diagram.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Optical fiber cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, Installer, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Product Certificates: For each type of product.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of BICSI certified Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Communications Pathways and Spaces: Comply with TIA-569-D.

D. Grounding: Comply with TIA-607-B.

2.2 HYBRID 12 SINGLE-MODE (OS2), 24 MULTIMODE (OM4), PLENUM RATED, INDOOR OPTICAL FIBER CABLE

A. Acceptable Manufacturers

1. Belden
2. Corning Cable Systems

B. Belden FIEDH12PK, Corning (contact manufacturer at time of order), or approved equivalent.

C. Minimum Required Features and Specifications

1. Single-mode:
   a. 9/125-micrometer, 12 fibers, nonconductive tight buffer, optical fiber cable (OS2).
   b. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.
2. Multimode:
   a. 850 nanometer, laser-optimized, 50/125 micrometer, 24 fibers, nonconductive tight buffer, optical fiber cable (OM4).
   b. Maximum Attenuation: 3.00 dB/km at 850 nm; 1.0 dB/km at 1300 nm.
   c. Minimum Overfilled Modal Bandwidth-length Product: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
   d. Minimum Effective Modal Bandwidth-length Product: 4700 MHz-km at 850 nm.
3. Standards:
   a. Comply with TIA-492CAAB for detailed specifications.
   b. Comply with TIA-568-C.3 for performance specifications.
   c. Comply with ICEA S-104-696 for mechanical properties.
4. Jacket:

a. Jacket Color: Black.
b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
   a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

2.3 850 NANOMETER LASTER-OPTIMIZED, 50/125 MICROMETER, PLENUM RATED, INDOOR-OUTDOOR MULTIMODE OPTICAL FIBER CABLE (OM4), 12-STRAND, TIGHT BUFFER

A. Acceptable Manufacturers

1. Belden
2. Corning Cable Systems

B. Belden FD4D012P9 or approved equivalent.

C. Minimum Required Features and Specifications

1. Standards:
   a. Comply with ICEA S-83-596 for mechanical properties.
   b. Comply with TIA-568-C.3 for performance specifications.
   c. Comply with TIA-492AAAD for detailed specifications.
2. Maximum Attenuation: 3.00 dB/km at 850 nm; 1.0 dB/km at 1300 nm.
3. Minimum Overfilled Modal Bandwidth-length Product: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
4. Minimum Effective Modal Bandwidth-length Product: 4700 MHz-km at 850 nm.
5. Jacket:
   a. Jacket Color: Black or Aqua
   b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
   c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).
6. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

2.4 OPTICAL FIBER CABLE HARDWARE

A. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

B. Source Limitations: Obtain optical fiber cable hardware from single source and from single manufacturer. Provide cable hardware form same manufacturer as optic fiber cable.

C. Closet Connector Housing

1. Acceptable Manufacturers

a. Corning
b. Belden

2. Corning CCH-04U and CCH-01U; Belden AX105565 and AX105563, or approved equivalents
3. Minimum Required Features and Specifications

a. Holds 12 CCH and 2 CCH connector panels
b. Four (4) rack units high or
c. One (1) rack unit high
d. Flush mount in 19” rack
e. Front and rear access

4. Additional Required Options / Parts

a. Corning Closet Connector Housing Panel CCH-CP12-A9 or approved equivalent

1) Holds 12 fibers, Single Mode (OS2)
2) LC duplex connectors

b. Corning Closet Connector Housing Panel CCH-CP24-E4 or approved equivalent

1) Holds 24 fibers, Multimode (OM/4)
2) LC duplex connectors

c. Corning Closet Connector Housing Panel CCH-CP12-E4 or approved equivalent

1) Holds 12 fibers, Multimode (OM/4)
2) LC duplex connectors

D. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

E. Patch Cords: Factory-made, dual-fiber cables in 36 inch (900 mm) lengths.

F. Connector Type: Type LC duplex complying with TIA-604-10-B.

G. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.

H. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to a patch panel or faceplate.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

A. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

B. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in interior locations.
2. Comply with requirements for pathways specified in Section 270528.10 "Pathways for Security Systems."

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before unreeling. Heat lamps shall not be used for heating.

9. In the communications rooms, provide a 10 foot (3 m) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Terminate cable on connecting hardware that is rack or cabinet mounted.
12. Placement of Cable into Conduit Risers: Provide conduit risers as indicated on the plans. Use Kellum grips and/or other hanger devices to support the vertical drop of cable and prevent any possible kinking of the cable after installation.
13. Minimum Bend Radius: For static storage, do not bend the cable at any location to less than ten times the outside diameter of the cable or as recommended by the manufacturer. During installation, the cable shall not be bent at any location to less than twenty times the outside diameter of the cable or as recommended by the manufacturer.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in communications spaces with terminating hardware and interconnection equipment.
2. Do not run cable through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping." Do not begin installation work until certificates of conformance or compliance, manufacturer's catalog data, and details for fire stopping of penetrations and joint systems showing compliance with the appropriate UL Design Number are approved by the Office of Safety Health and Environmental Management Fire Protection Engineer.

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B.

1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Cable Schedule: Install in a prominent location in each communications room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for communications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables.

D. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
3. Label each unit and field within distribution racks and frames.
4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.

E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:

1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

c. OTDR Test: Perform optical time domain reflectometer test in the 800 to 1300 nanometers wavelength band on the fiber optic cable after it is installed. Calibrate he optical time domain reflectometer to show anomalies of zero point two (0.2) dB as a minimum. If the optical time domain reflectometer test results are unsatisfactory, replace unsatisfactory segments with a new segment of cable at no cost to the Owner. Test the new segment of cable to demonstrate acceptability. Furnish photographs of the traces to the Owner for each circuit.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and submit electronically.

C. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Validation: Test random fiber strands at Owner/Engineer's discretion to confirm validity of test results. Contractor to perform cable testing in presence of Owner/Engineer using Contractor staff and utilizing same test equipment that was used for final acceptance testing by Contractor. Owner reserves the right to validate up to 100% of installed optical fiber.

END OF SECTION 271300.10

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Conditions, Drawings, and Division 1, General Requirements, govern the work of this section.

1.2 SUMMARY

A. Section includes:

1. Horizontal UTP Station Cable
2. Cable connecting hardware, patch panels, and patch cords.

B. Related Sections:

1. Section 270500 “Common Work Results for Communications” for additional general requirements associated with Division-27 Work.
2. Section 270528 “Pathways for Communications Systems” for work associated with horizontal cable systems.

1.3 TECHNICAL STANDARDS

All designs and installations shall be done in accordance with the codes and standards listed in Section 270500. The codes and standards are minimum requirements. The most stringent requirement between the codes, standards, and the Contract documents shall be followed. The contractor is responsible for the research of all codes, standards, and regulations, including federal, state and local, which are applicable to the project design. All work shall comply with the requirements of the latest edition of codes and regulations in use by the local jurisdiction at the time of the design and installation.

1.4 DEFINITIONS

A. General: Basic Contract definitions are included in other Division 01 and -27 Sections and other Contract Documents.

B. In addition, the following list of terms as used in this Specification shall be defined as follows:

1. AHJ: Authority Having Jurisdiction

2. AWG: American Wire Gage.
3. CAT6A: Category 6A UTP copper cable.
4. CMP: Communications plenum rated cable.
5. CMR: Communications riser rated cable.
6. FEP: Fluorinated ethylene propylene, an insulating material for plenum rated cables.
7. Permanent Link: The portion of the horizontal cabling from station outlet termination to TR termination. This may include a consolidation point in the span. It does not include the patch cords which plug into the equipment on each end.
8. PVC: Polyvinyl chloride, an insulating material for non-plenum rated cables.
9. NEC: National Electrical Code.
10. UTP: Unshielded twisted pair copper cable.
11. WAO: Work Area Outlet

1.5 SYSTEM DESCRIPTION

A. Work under this Section shall include the planning and coordination of telecommunications cable systems, the furnishing of necessary materials, and the labor and associated services required to install a complete working telecommunications horizontal cabling system.

B. Telecommunications horizontal cabling systems consist of the following subsystems:

1. Horizontal cable, terminations, and outlets.
2. Patch cords and cross-connects.
3. Cable identification tags and system labeling.
4. Record documents.
5. Warranty.

1.6 SUBMITTALS

A. All submittals shall be in accordance with Contract, Division 01, and Division 27 requirements.

B. Product Data: Submit manufacturer’s written detailed technical product information and instruction installations for each type of product proposed for installation.

C. Samples: Typical work area outlet (WAO), including the faceplate, faceplate label, connectors/jacks, port labels, cables (12-inches long), and cable label.

D. Shop Drawings: Plans providing point-to-point wiring diagrams of proposed pathway routes. Include cross-connection records and associated cut sheets.

E. As built drawings to be included in Operation and Maintenance Manuals. As built drawings shall depict the following: installed pathways layout(cable tray, conduits, J Hooks); location of all

telecom outlets; labeling of each telecom outlet; final IDF and MDF layouts; final wall and rack elevations; and one line riser diagrams for voice/data and grounding.

F. Warranties: Manufacturer's warranty shall be provided for the structured cable system. Warranty shall be for at least 20 years.

1.7 QUALITY ASSURANCE

A. Work performed shall be according to Project documents and manufacturer's written specifications.

B. Material and equipment shall be new, a product of the same manufacturer throughout the Project, and conform to grade, quality, and standards specified.

C. All items including cables, faceplates, and patch panels shall be labeled in accordance with OCIO labeling requirements and ANSI/TIA 606-C labeling standards. All means of labeling/identification shall be visible and clearly identifiable by OCIO personnel. All labels shall be machine generated or engraved. All labels shall be constructed and attached by means to ensure the lifespan of the label to be equal or greater than that of the device being identified.

D. Installer shall have BICSI and manufacturer trained technicians or shall have 10 or more years' experience doing installations for the Smithsonian Institution.

E. Comply with TIA-569-D Standards: Commercial Building Standard for Telecommunications Pathways and Spaces.

1.8 WARRANTY

A. Special Warranty: The telecommunications horizontal cabling system, as specified in this Section, shall receive a specific manufacturer's structured cabling system link/channel and applications warranty, specifying that the installation is free from defects in materials and workmanship. This extended warranty shall cover parts and labor for the duration of the extended warranty and no less than 20 years. This extended warranty shall include coverage of the electrical performance of cabling system to the specific category per American National Standards Institute / Telecommunications Industry Association / Electronic Industries Alliance (ANSI/TIA/EIA)-568-C Series performance criteria for "Permanent Link."

PART 2 -PRODUCTS

2.1 HORIZONTAL CABLE

A. General: Category 6A 100-ohm, 4-Pair, UTP CMP cable.

B. Conductors: Insulated conductors, 22-AWG to 24-AWG solid-copper fully-insulated with a flame retardant thermoplastic material (PVC, or equivalent). Insulated color code shall be per ANSI/TIA 568-D.2 Section 5.3.3.

C. Cable Sheath: The cable shall be unshielded. Outer jacket shall be seamless applied to and completely covering the internal components. Cable shall be imprinted with the manufacturer's name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation), and length marking in feet at regular intervals not to exceed 2 feet.

1. Flame Rating: Per NEC (Article 800) rated as CMP, and Underwriter's Laboratories (UL) listed as CMP.
2. Listed and labeled by an NRTL acceptable to an AHJ as complying with UL 444 and NFPA 70.

D. Cable Diameter: The maximum cable diameter shall be less than 7.5 mm (.295 in).

E. Electrical Performance and Transmission Performance: Meet or exceed ANSI/TIA568-D.2 for CAT6A UTP cabling.

F. Mechanical Performance: Shall comply with ANSI/CEA S-102-732-2009

G. Cable color coded as follows:

1. Yellow
2. White

H. Manufacturers: Subject to compliance with requirements, provide the following Manufacturers' or other manufacturers' comparable products:

1. Panduit/General Cable
2. Superior/Essex
3. Commscope
4. Approved equals by COR

2.2 PATCH PANEL

A. General: Patch panel shall meet or exceed TIA and ISO Category 6A component performance requirements. Patch panel shall be horizontally oriented for a 19-inch rack-mounted configuration.

B. Patch panels shall be modular panels housing multiple-numbered jack units with 110 termination IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

C. Patch panel shall provide port labeling abilities, icon compatibility, and rear cable management support.

D. Manufacturer: Subject to compliance with requirements, provide the following Manufacturers' or other manufacturers' comparable products:

1. Panduit
2. Legrand
3. Commscope
4. Siemon
5. Approved equivalent by COR

2.4 WORKSTATION FACEPLATES

A. Faceplate: Faceplate shall include required accessories, such as icons, blank inserts, and labels.

1. Standard Work Area Outlet (WAO): A duplex port, single-gang wall plate. Color to be provided by the architect or match the electrical outlet plates.
2. Refer to Drawings for port quantity per outlet type.

B. Manufacturer: Shall match the provider of the termination equipment.

C. Wall Phone Outlets: Faceplate for wall phone outlets shall come equipped with one Category 6A 8-position modular jack and two mounting studs.

2.5 CONNECTORS / MODULAR JACKS

A. Connectors shall be 8-position 8-conductor RJ45 modular type, Category 6A rated, and shall be intended for the termination of 4-pair UTP cables. The connector shall meet IEC 60603-7-1 thru IEC 60603-7-5 modular interface requirements and ANSI/TIA-570-B marking and mounting requirements.

B. All connectors shall be T568B wired. Modular jack shall be the same manufacturer as the patch panel. The outlet color should be approved by the architect.

C. Manufacturers: Subject to compliance with requirements, provide the following Manufacturers' or other manufacturers' comparable products:

1. Panduit
2. Legrand
3. Commscope
4. Siemon
5. Approved equals by COR

2.6 MISCELLANEOUS COMPONENTS

A. Velcro Cable Ties: Velcro cable ties shall be 3/4-inch wide and the color black.
B. Identification Products: Labels for patch panels, faceplates, and each end of the cable shall comply with TIA 606 and UL 969 for a system of labeling materials.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Pathways: Prior to installation, verify that pathways are complete and ready for cables.

B. Equipment and Telecommunication Rooms: Prior to installation, verify that ERs and TRs are complete and ready for cables. Complete and ready for installation requires the room to be dust free with the proper antistatic flooring installed. The rooms shall be complete with no additional mechanical, electrical, drywall, or plumbing work required.

3.2 INSTALLATION

A. Install products, components, accessories, hardware, etc, according to the manufacturer's written instructions.

B. All cables, faceplates, patch panels, and termination blocks shall be labeled in accordance with OCIO labeling requirements below and ANSI/TIA 606-B labeling standards. All means of labeling/identification shall be visible and clearly identifiable by OCIO personnel. All labels shall be machine generated or engraved. All labels shall be constructed and attached by means to ensure the lifespan of the label to be equal or greater than that of the device being identified.

1. Outlet numbering which shall be shown on the cable, faceplate, patch panel, and termination block shall consist of Telecom Room#-Drop Number-and Port Letter. The Telecom Room # is the Room number where the cables terminate. The drop number is done sequentially throughout the floor e.g. 001, 002, 003. The port letter is done using A, B, C, D starting from the top left port on the faceplate then going right on the same line and then going to the next line of port on the faceplate. Thus a quad faceplate being fed to Telecom Room 138 and being the thirty first faceplate would have the ports; TR138-031-A,B,C,D.

C. Horizontal Copper Cable: Copper cables shall be loosely bundled in orderly dressed groups of up to, but not more than, 48 individual cables from the point of entry into the TR to the termination point.

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.
2. Maintain maximum cable length of 295-feet from the termination in the TR to the termination at the outlet.
3. Installation: Place cables with no kinks, twists, or damage to the sheathing. Protect cables during installation. Replace cable if sheath is damaged during installation.

    a. Maintain a minimum bend radius of six times the cable diameter during and after installation.
    b. Maintain pulling tension within manufacturer's written recommendation or 110 N (25 lbf) maximum.
    c. Place and suspend cables in a manner to protect them from physical interference or damage.

4. Routing: When routing horizontally within TR, utilize the overhead cable support. When routing vertically within TR, fasten the cable bundles using approved cable ties to the wall-mounted vertical cable support every 24-inches on center.

    a. Route cables a minimum of 6-inches away from power sources to reduce interference from electromagnetic interference (EMI). When routing cables in the space outside of the TR, cables should be laid randomly in the pathway. This will help mitigate “Alien Crosstalk.”
    b. When routing cables in areas without primary horizontal pathways, install cables onto secondary pathways or approved support devices, such as Category 6A approved J hooks.
    c. Route cables at 90 degree angles, allowing for bending radius along corridors for ease of access. Do not route through an adjacent space if a corridor borders at least one wall of the room.
    d. Provide a minimum 7-foot sheathed cable slack loop at each end of the run in the TR and 1-foot of slack left in the work area after termination. In the TR, place the slack in the overhead cable support. At the workstation, store the slack using J hooks in the ceiling space before the conduit stub for the device.
    e. At the equipment bay in the TR where wall-mounted racks are used, route the horizontal cables down the hinged side of the equipment rack.

5. Termination: Per the manufacturer’s written instructions and ANSI/TIA-568-D standard installation practices, strain relieve cables at termination points, and terminate pairs on the specified connecting hardware.

    a. The maximum pair untwist at the termination point shall be 13 mm (.5 in).
    b. All connectors shall be terminated T568B modular jack pin/pair assignment.

6. Labeling: Each cable shall be labeled within 4” of each end. The cable label shall contain the Faceplate Outlet ID of the cable as shown on the faceplate. The label shall wrap around

the cable sheath with multiple instances of the ID printed so the ID can be read from different angles. The text on the labels shall be an uppercase, easily readable font without serifs. The label shall be manufactured for the purpose of identifying flexible communications cabling and shall be used only on flexible materials.

D. Patch Panels and Horizontal Management Panels: Install the discrete patch panels and horizontal management panels in the configuration as shown on the Elevation Drawings.

1. Installation: Patch Panels shall be mounted to the rails using screws in all four corners of the Patch Panel. Horizontal Management Panels shall be placed between each Patch Panel. Spaces shall not be left between Patch Panels and Horizontal Management Panels.
2. Termination: Per the manufacturer's written instructions and ANSI/TIA-568-D standard installation practices, strain relieve cables at termination points, and terminate pairs on the specified connecting hardware.

   a. The maximum pair untwist at the termination point shall be 13 mm (.5 in).
   b. All connectors shall be terminated T568B modular jack pin/pair assignment.

3. Labeling: All Patch Panels shall have 2 types of labeling: the identification of the actual patch panel and the identification of the ports on the patch panel.

   a. All patch panels shall be labeled as to the identity of the patch panel. The identification shall be derived based on Telecom Room, the rack in which it is mounted and a sequential letter, e.g. TR01-A-PP03, where TR01 is the Telecom Room, A is the rack, and PP03 indicates this is the third patch panel in the rack.

   b. All ports on the patch panel shall be labeled with the Outlet ID # and port per Section 3.2.B.1.

E. Outlet Faceplates: Install faceplates plumb, square, and at the same level as adjacent device faceplates. The hole cut out of the drywall shall not be visible on any sides of the faceplate. For surface raceway, color shall match electrical device and/or cover plate. All ports on the faceplate shall be labeled with the Outlet ID# and port per Section 3.2.B.1. The machine generated label shall be installed behind the faceplate's plastic label window to ensure it is permanent and does not fall off the faceplate.

F. Outlet Modular Connectors: In accordance with manufacturer's written instructions and ANSI/TIA-568-C standard installation practices, terminate pairs on the specified modular connector.

G. Wall Mounted Telephones: Install telephone to height noted on the Drawings and per the manufacturer's written instructions and in compliance with codes.
H. Wireless LAN Access Point Enclosures: Refer to Drawings for enclosure cabling service and installation requirements. If the outlet for the WAP is installed in a plenum space, use plenum rated surface mount boxes. Wireless LAN Access Points shall be labeled separately from the standard room outlet labeling. All Wireless LAN Access Points shall be grouped together on

the patch panel and be labeled W-001, W-002, through W-00N with N being the total number of Access Points.

I. Refer to Section 270500 “Common Work Results for Communications” for type of and installation requirements for labeling of cable and outlet labels.

3.3 FINAL REVIEW

A. The contractor shall test all cables for Category 6A compliance using a Level III tester per TIA 568-D. Soft copies and if asked for hard copies of the test results shall be provided to OCIO to review as the testing proceeds. No Pass*, a Pass within the error level of the tester, or Fail test results will be accepted.

B. Review installed products and work in conjunction with the COR. Develop a punchlist for items needing correction.

C. Issue punchlist to the COR for review prior to performing punchlist walk.

D. Repair defects prior to system acceptance.

E. Provide final as-built documentation per the contract including numbered drawings, final test results, and manufacturer’s warranty.

F. Review installed products and work in conjunction with the COR for sign-off.

END OF SECTION 271500

SECTION 271500.10 – SECURITY HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 “Common Work Results for Electronic Security”.

1.2 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Cable management system.
4. Cabling identification products.
5. Grounding provisions for twisted pair cable.
6. Source quality control requirements for twisted pair cable.
7. RS-232 cabling.
8. RS-485 cabling.
9. Low-voltage control cabling.
10. Control-Circuit conductors.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. FTP: Shielded twisted pair.

E. F/FTP: Overall foil screened cable with foil screened twisted pair.

F. F/UTP: Overall foil screened cable with unscreened twisted pair.

G. IDC: Insulation displacement connector.

H. LAN: Local area network.

I. Jack: Also commonly called an "outlet," it is the fixed, female connector.

J. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

K. RCDD: Registered Communications Distribution Designer.

L. RoHS: Restriction of Hazardous Substances

M. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

N. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

O. S/FTP: Overall braid screened cable with foil screened twisted pair.

P. S/UTP: Overall braid screened cable with unscreened twisted pairs.

Q. TIA: Telecommunications Industry Association

R. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

A. The maximum allowable Category 6 horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration Drawings and printouts.
3. Wiring diagrams and installation details of communications equipment, to show location and layout of communications equipment.

C. Category 6 Twisted pair cable testing plan.

D. Samples: Jacks and plugs.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, Installer, installation supervisor, and field inspector.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Category 6 Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of BICSI certified Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 600MHz.

B. Acceptable Manufacturers:

1. Belden

C. Belden 7852A or approved equivalent.

D. Minimum Required Features and specifications:

1. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
2. Conductors: 100-ohm, 23 AWG solid copper.
3. Shielding/Screening: Unshielded twisted pairs (UTP).
4. Cable Rating: Plenum.
5. Jacket: Blue.

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. Acceptable Manufacturers:

1. Belden

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Terminate cables with connecting hardware of same category or higher.

D. Source Limitations: Obtain twisted pair cable hardware from single source, from single manufacture; same manufacturer as cable.

E. Connecting Blocks:

1. 110-style IDC for Category 6.
2. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

F. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

G. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Belden AX103114

2. Features:
   a. Labeling areas adjacent to conductors.
   b. Replaceable connectors.
   c. 24 ports.

3. Construction: 16-gauge steel and mountable on 19 inch (483 mm) equipment racks.
4. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

H. Patch Cords: Factory-made, four-pair cables in 24 inch (600 mm) 36 inch (900 mm) lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

I. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.
3. Marked to indicate transmission performance.

J. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 GROUNDING

A. Comply with requirements in Section 27052610 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

B. Comply with TIA-607-B.

2.7 GENERAL WIRE AND CABLE REQUIREMENTS

A. Wire and cable jacket color: blue.

B. Minimum wire and cable requirements for selected equipment and devices are listed in the table below. Provide plenum rated cable and wiring which meets the manufacturer's requirements for all equipment and devices provided.

DEVICE	TO DEVICE	CABLE TYPE	BELDEN (PLENUM)
DGP-SWH	RM-4e	2C/18AWG 2C/24AWG Shielded	Belden 6300UH Belden 82841
DGP	Electric Strike	2C/18AWG	Belden 6300UH
DGP	Monitoring Device	2C/22AWG TP Shielded	Belden 82442
DGP	Annunciating Device	2C/22AWG Shielded	Belden 82442
DGP	Active Alarm Devices (Requiring Power)	2C/18AWG 2C/22AWG Shielded	Belden 6300UH Belden 82442
DGP	Passive Monitoring Devices (Not Requiring Power)	2C/22AWG Shielded	Belden 82442
DGP	Output Device	2C/22AWG Shielded	Belden 82442
DGP	Card Reader - Data	2C/22AWG Shielded	Belden 82761
DGP	Card Reader - Power	2C/18AWG TP	Belden 88760
RM-4e	Card Reader	6C/22AWG Shielded	Belden 82777
RM-4e	Request to Exit	2C/18AWG 2C/22AWG Shielded	Belden 6300UH Belden 82442
RM-4e	Passive Monitoring Devices (Not Requiring Power)	2C/22AWG Shielded	Belden 82422
RM-4e	Output Device	2C/22AWG Shielded	Belden 82422

2.8 CABLE IDENTIFICATION PRODUCTS

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. Brady Corporation
2. Or approved equivalent

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.9 SOURCE QUALITY CONTROL

A. Factory test cables on reels according to TIA-568-C.1.

B. Factory test twisted pair cables according to TIA-568-C.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 WIRING METHODS

A. All security system wiring must be new. Remove existing wiring not noted for reuse.

B. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters, unless otherwise indicated. Conceal raceway and cables, except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 270528.10 "Pathways for Security Systems."

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

E. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer and compatible with the security system. Number and size and type of conductors shall be as recommended by the security system manufacturer, but not less than 22 AWG twisted shield pair.

F. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring, a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.

G. Wiring conductors provided in elevator hoist ways and traveling cables shall be listed and approved for elevator use. Conductor insulation shall be TFN, TFFN, THWN, THHN or other insulation designated as Flame Retardant. Insulation rating shall equal or exceed the maximum normal circuit voltage applied to any conductor within the cable or raceway.

H. Method of Wiring

1. General
   a. Wire each alarm, trouble, and supervisory signal, initiating circuit, communication circuit, and each security notifying appliance circuit for supervised operation.
2. Wiring within Cabinets
   a. Provide wiring within cabinets installed parallel with or at right angles to the sides and back of the enclosure. Connect conductors which are terminated, spliced, or otherwise interrupted in any enclosure associated with the security system to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make all connections with either crimp-on terminal spade lugs or approved pressure type terminal blocks. Secure terminal blocks in each junction box to the junction box cover plate. No “stick-on” cable ties shall be used within the enclosure.
3. Installation in Ducts or Conduits
   a. Use a cable lubricant compatible with the cable sheathing material on all cables pulled. Attach pulling fixtures to the cable strength members. If indirect attachments are used, match the grip diameter and length to the cable diameter and characteristics. If indirect attachment is used on cables having only central strength members, reduce the pulling forces to ensure the fibers are not damaged from forces being transmitted to the strength member. During pulling, continuously monitor the cable pull line tension and not exceed the maximum tension as given by the cable manufacturer. The mechanical stress placed upon a cable during installation shall not twist or stretch the cable.
      1) Use a cable feeder guide between the cable reel and the face of the duct or conduit to protect the cable and guide it into the duct or conduit as it is played off the reel. As the cable is played off the reel, carefully inspect it for jacket defects. Take precautions during installation to prevent the cable from being kinked or crushed and the minimum bend radius of the cable is not exceeded at any time. Hand feed and guide cables through each manhole and apply additional lubricant at all intermediate manholes.
      2) When practicable, use the center pulling techniques to lower pulling tension. That is, pull the cable from the center point of the cable run towards the end termination points. The method may require the cable to be pulled in successive pulls. If the cable is pulled out of a junction box or manhole, protect the cable from dirt and moisture by laying the cable on a ground covering.
4. Vertically Run Cable
   a. When possible, use gravity to assist in cable pulling; pull cable from top of run to bottom of run. Hand-pull cables if possible; if machine assistance is required, monitor tension and do not exceed the specific cable tension limits. After installation, relieve vertical tension on the cable at maximum intervals of 100 feet (30.48 m) using a split support grip.
5. Termination
   a. End-of-line supervisory resistors or devices are to be provided at the sensor device location. The end of line resistor network shall be per manufacturer’s recommended resistor packs.
      1) Wire field devices with tamper circuits in series with the supervised alarm input.

I. Cable Installation

1. Protect all circuits to avoid interruption of service due to short-circuiting or other conditions which may adversely affect the connecting devices. Each individual signaling circuit shall be classified as a circuit pair.
2. Furnish screw terminal blocks or connectors for all cables which interface with racks, cabinets, consoles, or equipment modules. No more than 2 mm of exposed bare wire may show when either crimped or fastened to a connector block or terminal strip.
3. Permanently label every cable or wire at each end. Marking labels used on cables shall correspond to labels shown on as-built drawings and matrix sheets. Utilize a cable administration and labeling solution compliant TIA/EIA-606-A, such as Panduit TIA/EIA-606-A compliant Cable Identification and Labeling System. Wire cable numbers cannot repeat anywhere on the project. Each terminal of each field terminal strip shall be permanently labeled to show the zone, instrument or item served. Terminal blocks shall be numbered by circuit pairs, such as 1 to 25, 26 to 50, etc. Provide labels as follows:
   a. PACS: “SWH point #”.
   b. Cameras: “Cam #/ NSW #/Port #”.
   c. Intercom: “Intercom/NWS #/Port#.
4. Exercise care in wiring to avoid damage to the cables or the equipment. All joints and connections shall be made with mechanical butt splice connectors. The crimping tool used shall be recommended by the manufacturer. Wire nuts shall not be an acceptable splice method.
5. To reduce the possibility of signal contamination, all cables shall be grouped according to the signals being carried. The horizontal and vertical cable runs should be bundled or grouped as follows:
   a. Low Voltage Power
   b. Signal, Control Cables, and Video Cables
6. Splices shall not be permitted in system wiring between components which are incorporated in the system. Wiring runs must terminate at either a system component or a junction box where wiring is interconnected using terminal strips or connectors. Wire ends shall be prepared for attachment to component terminals in accordance with the recommendations of the equipment manufacturers. If there is no alternative and a wire/cable splice must be made, the Contractor shall notify Owner and request approval through a formal RFI process prior to making the wire splice.
7. Connections at devices shall be fastened with approved crimp connectors. No wire nuts will be permitted. Wire should be twisted four times before a crimp connector is applied. The Manufacturers crimping tool shall be utilized for the crimp connectors of choice. Environmental connectors shall be used in harsh or outdoor environments. Devices requiring connections within metal extrusions associated with perimeter windows and doors are considered to be a harsh environment.
8. All mounted wire ties shall be the screw down type. Wire ties utilizing only an adhesive back are not acceptable.
9. Heat shrink tubing must be installed on all cable ends within cabinets.
10. Cable shields are to be grounded only at the DGP end. Shields are to be carefully insulated to prevent conductor shorts.
11. Permanent labels, attached to each cable end, shall be close to cable ends in cabinets and not hidden from view by cable ties. Labels must be visible without having to cut cable ties to read the number.

J. Grounding Practices

1. The existing single system ground point shall be maintained for all security and security related systems described in the BICSI guidelines and is to be provided and installed by the Contractor.
2. Under no circumstances shall either the conduit or AC neutral be used for the security system ground reference point.

K. Control of Electromagnetic Interference (EMI)

1. The control of EMI is critical to the reliable operations of the systems described in these specifications. It is the responsibility of the Security Contractor to ensure all equipment and systems proposed meet FCC requirements and certifications for type regarding electromagnetic emissions. Submit evidence of such certifications with their pre-fabrication submittals.
2. All equipment shall be installed in accordance with manufacturers' specifications and recommendations to assure compliance with FCC certifications and requirements. This shall include proper installation to maintain case integrity; proper fastening of conductors, wires, cables, and connectors; use of appropriate connectors and fasteners; and following manufacturers' recommendations for grounding practices.
3. Certify compliance with manufacturers' recommendations and specifications regarding control of EMI.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.

10. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
11. In the communications room, install a 10 foot (3 m) long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in communications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping." Do not begin installation work until certificates of conformance or compliance, manufacturer's catalog data, and details for fire stopping of penetrations and joint systems showing compliance with the appropriate UL Design Number are approved by the Office of Safety Health and Environmental Management Fire Protection Engineer.

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Cable Schedule: Install in a prominent location in each communications room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

D. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware.

E. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

C. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 271500.10

SECTION 274116 - AUDIOVISUAL SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All AV series contract drawings and single-line diagrams.

C. All Telecommunications series contract drawings.

D. See Division 27 for communications cabling, cabling pathways, terminations and physical mounting of cable hangers and cable trays.

1.2 SUMMARY

A. Description of Work: Work of this Section includes, but is not limited to, the following:

B. The Contractor shall provide labor, materials and equipment necessary to provide complete audiovisual systems defined in this specification.

C. The Contractor shall be responsible for delivering a turnkey system to the Owner before the occupancy date specified.

D. The Contractor shall support the Owner in their effort to complete the project in accordance with the aforementioned schedule. Contractor is required to participate in all weekly construction meetings as a full member of the project team.

E. The Contractor shall furnish all equipment and materials, whether specifically mentioned herein or not, to ensure a complete and operating system. The NIC (Not in Contract) and OFE (Owner furnished equipment) items and materials are specifically exempted from this requirement. The Contractor shall coordinate with “others” on their components when interfaced, or integrated, with other Trades, or Owner, marked in Contract Documents as NIC or CFE.

F. The Contractor shall generate all shop drawings and information for the complete installation and wiring of the system. The Contractor shall provide (or sub- subcontract) for the onsite installation and wiring, and shall provide ongoing supervision and coordination during the implementation phase.

G. The Contractor shall be responsible for the initial adjustment of the systems as herein prescribed and shall provide all test equipment for the system checkout and acceptance tests.

H. CONTRACTOR Supplier/Installer is required to provide client onsite training in the operation and maintenance of the systems for personnel designated by the C.O.R. (Contracting Officer’s Representative). Training shall be provided no later than 2 weeks after final acceptance of the A/V systems and a second Training Session 1 month after end-users have occupied the system.

The Contractor shall produce and develop an instructional training manual showing all the specific functionalities of the A/V system that the Contractor installed. This manual will be made to assist the end-users on how to operate specific functions of all aspects of the A/V Systems. The Training Manual will include "screen shots" of specific functions of Touch Panel and other operational devices as well as written descriptions of how to manipulate those functions.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. See Division 26 sections for all floor boxes, table boxes, conduits, wire ways, connection boxes, pull boxes, junction boxes, and outlet boxes permanently installed in walls, floors, and ceilings.

B. See Division 26 sections for all electrical breaker panels required to power the audiovisual systems.

C. Furniture and cabinetry in support of audiovisual technology.

D. Heating and Air-Conditioning equipment in support of audiovisual technology.

E. Room lighting equipment and electronic dimming and switching equipment in support of audiovisual presentations and electronic conferencing.

1.4 APPLICABLE CODES AND STANDARDS

A. The following international codes and standards are applicable to this project:
1. All local codes and regulations shall be strictly observed. Standards listed below shall be the latest edition and adhered to as applicable.

2. ANSI/INFOCOMM 10:2013, Audiovisual Systems Performance Verification

3. ANSI/INFOCOMM 2M-2010

4. ANSI/INFOCOMM 3M-2011, Projected Image System Contrast Ratio

5. ANSI/INFOCOMM 4:2012, Audiovisual Systems Energy Management

6. AVIXA A102.01:2017 (Formerly ANSI/INFOCOMM A102.01:2017), Audio Coverage Uniformity in Listener Area

7. CEA/CEDIA/INFOCOMM J-STD-710, Audio, Video and Control Architectural Drawing Symbols Standard

8. AVIXA F501.01:2015 (Formerly INFOCOMM F501.01:2015), Cable Labeling for Audiovisual Systems

9. AVIXA V202.01:2016 (Formerly ANSI/INFOCOMM V202.01:2016), Display Image Size for 2D Content in Audiovisual Systems

10. BICSI- Standard for Installing Commercial Building Telecommunications Cabling; Latest edition

11. BICSI TDMM - Telecommunications Distribution Methods Manual; Latest edition

12. TIA-526-7 (OFSTP-7)-2002+A1:2008, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.

13. TIA-526-14-B-2010 (OFSTP-14), Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 Edition 2, Fiber-Optic Communications Subsystem Test Procedure- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement.

14. ANSI/TIA-568-C.0–2009+A1:2010+A2:2012, Generic Telecommunications Cabling for Customer Premises.

15. ANSI/TIA-568-C.1–2009+A1:2012, Commercial Building Telecommunications Cabling Standard.

16. ANSI/TIA-568-C.2–2009+A1:2010, Balanced Twisted-Pair Telecommunications Cabling and Components Standard.

17. ANSI/TIA-568-C.3–2009+A1:2011, Optical Fiber Cabling Components Standard.

18. ANSI/TIA-568-C.4–2011, Broadband Coaxial Cabling and Components Standard.

19. ANSI/TIA-569-C–2012, Telecommunications Pathways and Spaces.

20. ANSI/TIA/EIA-598-C–2005, Optical Fiber Cable Color Coding.

21. ANSI/TIA-606-B-2012, Administration Standard for Commercial Telecommunications Infrastructure.

22. ANSI-J-STD-607-A

23. ANSI/TIA-607-B-2011, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

24. ANSI/TIA-1152–2009, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling.

25. ANSI/TIA-1183–2012, Test Fixtures for Balun-Less Measurements of Balanced Components and Systems.

26. NFPA 70- National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

27. Underwriters Laboratories, Inc. (UL)

28. ASTM International

29. NEMA – National Electrical Manufacturers Association

30. NECA– National Electrical Contractors Association Standards for Good Workmanship

31. ISO/IEC 11801

1.5 DEFINITIONS

A. Within this specification, the following definitions shall apply:
1. The term "Owner" shall refer to Smithsonian Institute
2. The term “General Contractor” shall refer to the General Contractor.
3. The term "Architect" shall refer to Architect of Record, Quinn Evans Architects
4. The term, “Consultant” or “AV consultant” shall refer to AV Consultant working for the Architect of Record, GHD Inc.
5. The term "Contractor" shall refer to the Audiovisual Systems Contractor who has been awarded the contract for the subject job and who has responsibility for performance of the work specified herein.
6. The term COTR shall refer to the Owner’s contracting office technical representative.
7. The term "Specified elsewhere" shall refer to material and work which is related to this contract and for which the AV contractor is not responsible except as otherwise detailed herein. Some or all of these items may be included in the overall electrical contract.
8. The term "OFE" shall refer to "Owner Furnished Equipment", which will be provided by the Owner to the Contractor. The Contractor shall be responsible for installing and integrating this equipment as detailed herein.
9. The term "N.I.C." shall refer to "Not In Contract", scope not included in the AV contractor's scope of work.
10. The term infrastructure only shall refer to future or planned equipment items and capabilities of the audiovisual system. The Contractor is required to provide reasonable and appropriate means to facilitate the future integration of these components within the system design. Wherever possible, the systems design specifications include provisions for these anticipated expansions. The Contractor shall ensure that the installation will readily support these items, including, all system cabling systems to the proposed equipment locations, appropriate space for said equipment is available within new equipment racks, credenza, and, lecterns; with existing TR’s, and audiovisual control system software anticipating said future items.
11. The term "shall" is mandatory; the term "will" is informative; the term "should" is advisory; and the term "provide" means furnish and install.

1.6 SUBMITTALS

A. Five (5) submittals are required:
1. Submittal 1 – Contractor qualifications/Drawing standards
2. Submittal 2 – Product datasheets
3. Submittal 3 – Shop Drawings
4. Submittal 4 – Programming/Training document
5. Submittal 5 – Final Documentation

B. Submittal 1 – Contractor qualifications/Standards

1. Contractor qualifications - See the Quality Assurances section of this specification for contractor qualification requirements.
2. Drawing standards – The contractor is provide their drawing standards and a sample enlarged plan, RCP, elevation, rack/console elevation, detail, and diagram.

C. Submittal 2 – Product datasheets
1. Product data: Manufacturer's product information and data sheets for all equipment items, cabling and materials provided.
    a. Include an index that includes make, model, page number, and applicable room type or number.
    b. Organize datasheets alphabetically by manufacturer.
    c. Datasheets shall be from the OEM and not resellers.
    d. Do not include equipment manuals.
    e. Only include product datasheets for equipment once in the submittal, no matter how many times or systems that piece of equipment is used in the project.
    f. Highlight only equipment specified for use on project.
    g. Provide proof the AV Contractor is authorized to resell the products specified.

D. Submittal 3 – Shop Drawings
1. For purposes of quality assurance and performance verification, prior to fabrication the Contractor shall submit (3) three copies of the following information for approval by the Owner, Architect and AV Consultant. Drawing submittal shall be on reproducible media. This information shall include, but is not limited to, the following:
    a. Line drawings - Complete system construction and point to point wiring schematic drawings, including all component values and showing complete letter and number identification of all wire and cable as well as jacks, terminals and connectors.
    b. Front and rear mechanical drawings of each equipment rack that shows placement (elevation) of all equipment.
    c. Reflective ceiling plan drawings showing placement of all ceiling mounted equipment.
    d. Furniture drawing
    e. All panels, plates, and designation strips, including details relating to terminology, engraving, finish and color.
    f. Schematic drawings of all custom components, assemblies and circuitry.
    g. All unusual equipment modifications.
    h. Cable run sheets for all cables, not just room to room cable pulls
    i. Sample cable labels.
    j. Connector wiring diagrams.
    k. Patch panel assignment layout drawings.
    l. All items of equipment whether a stock manufactured item or custom built shall be supported by complete and detailed schematic drawings and replacement parts lists. No "black boxes" or unidentified components shall be acceptable.
    m. Verification of the focal lengths of video display/projector/wall and end-user seating placement to achieve the specified image sizes.

E. Submittal 4 – Programming/Training document
    a. Audiovisual control system Graphical user interface (GUI).
    b. Audiovisual control system requirements/ SOW document for programmer.
    c. Remote Control Panel layouts with button function descriptions.
    d. Training quick reference guide (QRG).
    e. Training Manual.

F. Submittal 5 - Final Documentation

1. At the completion of the installation, the Contractor shall submit final "as-built" documentation, including the following:
   a. Equipment manufacturer's operation and maintenance manuals for each piece of equipment. Product data sheets shall be collated and indexed alphabetically and sorted per system in a D-type three ring binder.
   b. Same Equipment manufacturer's operation and Maintenance manuals, and Training Manual, described above for Shop Drawings. These documents shall be electronically saved as Adobe Acrobat PDF files onto a CD-ROM. The CD-ROM shall be labeled for "Section 274116 AUDIOVISUAL, AS-BUILT Documentation, Operation and Maintenance Manuals" with the project name, contractor's name and AV Contractor contact info and date of issue.
   c. "As built" drawings that include any updates (red-lines) made in the field to the shop drawings. This package to install final versions of all shop drawings and is to include, but not limited to, line, elevation, rack, floor, including floor and reflected ceiling plans showing equipment and device locations and conduit pathways, system functional block drawings including all input and output circuit cable and terminal block numbers, all jack field circuit I.D. designations and every equipment item required for the system configuration. The drawings shall include labeling for "Section 274116, Audiovisual, AS-BUILT Documentation" with the project name, contractor's name and Contractor contact info and date of issue.
   d. Same "As built" drawings described above for every equipment item required for the system configuration, electronic files, saved as editable AutoCAD 2010 (or newer version) and also as Adobe Acrobat PDF files onto a CD-ROM. The CD-ROM shall be labeled for "Section 274116, Audiovisual, AS-BUILT Documentation, System Drawings" with the project name, contractor's name and AV Contractor contact info and date of issue.
   e. A System Operation and Training Maintenance Manual. This manual shall be produced by the Contractor specifically for the systems detailed herein and provided in Microsoft Word (editable) and Adobe Acrobat PDF files onto a CD-ROM. The CD-ROM shall be labeled for "Section 274116, Audiovisual, AS-BUILT Documentation, System Drawings" with the project name, contractor's name and AV Contractor contact info and date of issue.
   f. The "Operation" section shall describe all typical procedures necessary to activate each system to provide for the functional requirements as listed under the Detailed Specifications.
   g. The reader of this manual shall be assumed to be technically competent, but unfamiliar with this particular facility. It is estimated that this manual will require a minimum of 5 pages for each room and functional system configuration.
   h. The "Maintenance" section shall provide a recommended maintenance schedule with reference to the applicable pages in the manufacturer's maintenance manuals. Where inadequate information is provided by the manufacturer, the Contractor shall provide the information necessary for proper maintenance.
   i. Detailed equipment list with a minimum of the following information: Room number, location, CLIN, manufacturer, model, description, MSRP, serial number, manufacturer warranty term, manufacturer warranty start date, manufacturer warranty end date, delivery date, and system acceptance date.
   j. All documentation to be provided within 14-calendar days of the room’s acceptance.

1.7 WARRANTY

A. The Contractor shall provide a written warranty on the entire system, installation workmanship, materials employed and on the individual pieces of equipment installed. The system warranty shall be for 1 (one) year commencing from the date of final system acceptance by the Owner. This warranty shall obligate the Contractor to provide all equipment, material, and labor during the warranty period, in the event of system or equipment malfunction.

B. To maintain certain manufacturers' warranties, said equipment must be installed, aligned and serviced by those authorized by said manufacturer to perform those duties. If the Contractor is not authorized by said manufacturer, it is his sole responsibility to make the appropriate arrangements and bear all cost and consequences thereof.

C. All video and computer image display panels, image projection products and projection lamps are warranted only to the extent as provided for under the manufacturer’s warranties and guarantees.

D. All manufacturer's equipment warranties shall be activated in the Owner's name and shall commence on the date of system acceptance. In the case of contractor modified equipment, the manufacturer's warranty is normally voided. In such cases, the Contractor shall provide the Owner with a warranty equivalent to that of the original manufacturer.

E. Service and Maintenance

1. WARRANTY PERIOD: During the initial one-year warranty period, the audiovisual contractor shall provide onsite service, repair and maintenance for the audiovisual system. First year service and maintenance shall be provided at a fixed price, regardless of the number of service visits required to maintain system operation and performance, including video projector alignment. On the Master Recapitulation of Costs, enter your first year service contract costs.

2. FIRST YEAR SERVICE AND MAINTENANCE consists of telephone support and assistance, on-site services and preventative maintenance inspections. In all cases, the audiovisual vendor shall provide knowledgeable and capable staff technicians in the performance of all tasks required.

3. TELEPHONE ASSISTANCE: Vendor shall respond via telephone within two hours to any request for service. This first contact should outline the nature of the problem or functional anomaly. The vendor shall make available an individual knowledgeable with the installed system who can address specific system issues described by system operators.

4. NON-EMERGENCY ON-SITE SERVICE: The vendor shall provide capable technicians for on-site service of systems equipment or control software within 1-business day of reporting the issue if the issue cannot be resolved over the phone. In all cases, the technicians dispatched must be familiar with the installed system with complete knowledge of the products used in the systems configuration. Technicians dispatched must have complete ability to address the nature of the system anomaly or performance difficulty described.

5. EMERGENCY ON-SITE PROVISION: During the first year service contract, the vendor may be called upon to provide on-site service on an emergency basis. For

whatever reasons, the Owner may request a qualified technician be onsite to perform service within 4 hours from notification. This emergency service should be available 7 days per week, 24 hours per through a communications hierarchy established by the Owner and Contractor.

6. PREVENTATIVE MAINTENANCE INSPECTIONS (PMI): This service shall include a minimum of four (4) quarterly visits to perform operation checks of the equipment in each room; to clean screens, projector lenses and other critical surfaces; to lubricate moving parts as recommended by the respective manufacturers; and to adjust and align projectors to maintain optimum registration and focus. Additional service visits, above the four visits above, are included in the first year warranty, subject to the time response obligations outlined above. No limit to the quantity of service visits is expressed or implied.

1.8 DELIVERY, STORAGE & HANDLING

A. Refer to SECTION 01600 – MATERIAL AND EQUIPMENT for provisions and requirements pertaining to Product Delivery, Storage and Handling.

B. Costs of all shipping to the site, and of all unusual storage requirements, shall be borne by the Contractor. It shall be the responsibility of the Contractor to make appropriate arrangements, and to coordinate with authorized personnel at the site, for the proper acceptance, handling, protection, and storage of equipment so delivered.

C. Until site conditions are ready for installation of the AV equipment, same AV equipment must be received and stored offsite by the Contractor in suitable environmental conditions for sensitive electronic equipment.

D. A detailed equipment list to be provided to the Owner before any deliveries with a minimum of the following information: Room number, location, CLIN, manufacturer, model, description, MSRP, serial number, manufacturer warranty term, manufacturer warranty start date, manufacturer warranty end date, and delivery date.

1.9 UNION LABOR

A. The Contractor is responsible for verifying with the General Contractor if Union labor is required for this project. If required, the vendor shall secure authorized union labor for the tasks and activities requiring union labor as needed. The costs for union labor should be included with the Contractor's proposal.

1.10 PERMITS

A. The Contractor shall secure all appropriate permits for low voltage cable installation required by the local jurisdiction. Said documents shall be provided to the Consultant and Owner's project manager prior to the commencement of on-site installation. Costs for permits and accompanying inspections and documentation shall be included in the Contractor's proposal.

1.11 OWNER TRAINING

A. The Contractor shall provide (2) separate on the job training by a suitably qualified instructor(s), to personnel designated by the Owner, to instruct them in the operations, functions, and maintenance of the systems. In the event the Contractor does not have qualified instructors on staff for certain sophisticated equipment, a manufacturer's representative for such instruction will be provided by the Contractor at no additional cost to the Owner.

B. All training shall take place after the systems are operational and accepted by the Owner. As AV systems are completed and the Owner assumes occupancy, the Contractor is also expected to provide training of AV systems as they are completed as well. A second training session is to occur approximately 30-days after the ignition training to address any questions or issues end-users have experienced with the A/V system during the first month of operation.

C. Each of the (2) separate training sessions should including a minimum of two (2) 2-hour and one (1) 4-hour training sessions per room on the systems included in this specification. The 2-hour training sessions are intended for office staff to obtain the basic knowledge to operate the system. The 4-hour training sessions are intended for higher level technical instruction for the Owner's technical operations staff and is to include basic troubleshooting techniques. Each session is to accommodate up to 6 students. The Contractor is to provide a hard copy of the System Operation and Training Maintenance Manuals for each student. The Contractor is to leave a bound and laminated operations manual in each room

1.12 CONTENTS OF CONTRACTOR'S PROPOSAL

A. Quality Assurances
   1. CONTRACTOR QUALIFICATIONS: The Contractor shall be a firm with at least five years of experience in the fabrication, assembly, installation, and maintenance of Audiovisual systems of similar magnitude and quality as specified for this project.
      a. The Contractor shall provide documentation that must identify a minimum of three (3) specific, similar projects of the same or greater magnitude within the past 5-years. Of those projects descriptions submitted, the Contractor must provide current contact names and telephone numbers, as well as job description, with a clear delineation between labor and equipment costs, as well as duration of project. The descriptions supplied must clearly indicate that the firm submitting was actively involved in these projects and that the firm submitting has been actively involved for at least five years in projects of this magnitude.
      b. The Contractor shall include copies of letters and/or certificates of proof of training certification by the following: industry Certifications e.g. CTS, CTS-I, CTS-D, PMP, etc.
      c. The Contractor shall include copies of Manufacturer Product Training/Certification for the products specified by the individuals who will be working on the project. Note: the individuals working on the project must hold certifications appropriate to their job function for the products specified on the project.
      d. The Contractor shall include copies of letters and/or certificates from the OEM of proof of resale authorization for the products specified.
      e. The Contractor shall provide resumes for the key project team including the project manager, design engineer, control system programmer, and installation supervisor.
      f. The Project Manager shall have the following minimum certifications
         1) AVIXA CTS

2) Project Management Professional PMP

g. The Design Engineer shall have the following minimum certifications:
   1) AVIXA CTS-D
   2) Extron XTP Engineer

h. The Installation Supervisor shall have the following minimum certifications
   1) AVIXA CTS-I
   2) Extron XTP Systems Technician

i. The Field Engineer shall have the following minimum certifications
   1) AVIXA CTS-I
   2) Extron XTP Engineer

j. The control system Programmer shall have the following minimum certifications:
   1) AVIXA CTS
   2) Extron XTP Engineer
   3) Extron Authorized Programmer (EAP) or Extron Qualified Independent Programmer (EQIP)
   4) Extron Control Professional

k. The Contractor shall have an office within 50-miles of the customer site staffed by qualified audiovisual field maintenance technicians capable of diagnosing and resolving system issues without the assistance of others.

l. Any field maintenance technician dispatched to the client site to troubleshoot the Audiovisual System shall have the following minimum qualifications:
   1) 3-years of experience in the audiovisual industry
   2) CTS certification
   3) AVIXA CTS
   4) Extron XTP Engineer
   5) Extron Control Professional

2. QUALITY OF MATERIALS AND EQUIPMENT: All materials and equipment supplied by the Contractor shall be new and shall meet or exceed the specified equipment in all respects. Refurbished or B stock equipment is not authorized. The Contractor shall supply the latest model, available at the time of bidding, of each piece of equipment. If applicable to this project, the Contractor shall evaluate all specified CFE items and notify the Owner and Consultant if those items are functionally deficient in any manner.

B. Equipment Costs: The Contractor must detailed equipment lists with the submission of their proposal. Each piece of equipment shall be individually priced.. Line item equipment costs shall reflect all required modifications and accessories. Bidder shall be responsible for verification of all electronic costing formulas and to verify that itemized pricing and all total prices are accurate on each form, including a Bid Price Summary. Equipment totals from the equipment list shall be entered in a Bid Price Summary.

C. Engineering and Labor Costs: Engineering and Labor Costs shall also be itemized on the Bid Price Forms. Engineering shall include, but is not limited to, all required engineering services for design, drawings preparation, and preparation of any technical documentation. Labor shall include, but is not limited to, all preparation, fabrication, modification, assembly, rack wiring, and installation performed on the Contractor's premises and all installation, wiring, termination, coordination and supervision, testing, training, etc. performed on the Owner's premises. These costs shall include the labor costs for the first year preventive maintenance services.

D. General Conditions Costs: General Conditions Costs shall include all general conditions costs, administrative costs, overhead expenses, profit, shipping, insurance, bonds, warranties and guarantees.

E. End User Software Licensing Agreement: Include submission of Contractor's End User Software Licensing Agreement for review by the Owner. This document should assume that the Owner shall own all rights to edit, copy and distribute all Contractor authored programming, configurations, application, and documentation (drawings, O&M manuals, equipment lists, etc.) files for audiovisual control systems, network, audio digital signal processor, video signal processors, electronic annotation systems, content creation and content management systems, and any other applications specifically authored for the scope of this project. The Contractor shall provide the Owner with all files stored on three copies of a CD-ROM disk within 14 calendar days of room acceptance. Owner will review this document and negotiate final contents of this document with the Contractor.

F. Alternate Equipment
1. All bids shall be submitted on the basis of the specified equipment. The Bidder may propose alternate equipment, as a secondary proposal against the products specified herein. Alternate equipment is to include all required support systems that change as a result of the alternate. Submit your primary cost proposal using the equipment items specified and all "alternate" presented in a secondary cost proposal.
2. Proposals for alternate equipment will receive careful and equitable consideration if the differences do not depart from the overall intent of the design and operation of the system, and are in the best interests of the Owner.
3. Proposals for alternate equipment shall be accompanied by full technical information, cut sheets and specifications for the equipment so proposed. The Bidder shall identify the substantive differences between the alternate and the specified equipment.

G. Exceptions and Proposed Modifications
1. Should the Bidder have recommendations that will enhance the performance of the system, or reduce costs without loss of performance, such comments shall be made in the bid submission. All suggestions that are of value to the Owner will be taken into consideration in the evaluation of the bid returns. All such proposals shall be made as "alternates", with the appropriate cost modifications shown separate and apart from the costs of the system "as specified".
    a. Any and all exceptions to these specifications and related drawings must be made with the bid submission. In the absence of exceptions, these specifications and related drawings shall be binding in letter and intent on the successful Bidder. It will further be assumed that the Bidder has examined the design and specifications in detail, and is prepared to take full responsibility for the performance of the complete installation as designed and specified.

H. Statement of Compliance: The bidder shall, with this response, submit a letter of compliance that clearly states his understanding as to the letter and intent of this specification. Failure to supply such statement with the bid response may be cause for disqualification.

I. Schedule of Implementation
1. The contractor should provide the Architect, Audiovisual Consultant and Owners project manager with the anticipated schedule of pertinent terminal dates after award of sub-contract for completion of design, pre-installation work, on-site installation work, testing and acceptance.

2. The Contractor should also notify all parties of any equipment requiring anticipated long lead times, which may have a negative impact on the published schedule of completion.
3. If the Contractor feels the proposed schedule is insufficient, that information shall be provided in your proposal submission. Changes or alterations of this schedule may result from the activities of other trades; the owner will make every effort to maintain these target dates with the full expectation the Contractor shall complete their work before occupancy. Your firm's participation in this project is as a team member, expending every effort to ensure completion by the date provided regardless of changes and alterations, is expected.

PART 2 - PRODUCTS

2.1 GENERAL

A. This narrative section of this specification defines the details of the audiovisual system to be supplied and installed. All other audiovisual systems for CATV/MATV are specified under other Sections.

B. This building also includes infrastructure for AV technology not currently included in the scope of this document. The AV technology for the remaining areas are intended to be designed and procured for installation at later date.

C. The naming of manufacturers and designations of specific products is for purposes of identifying and describing required functions and not to limit competition. Other manufacturers and models, capable of producing the same function, having the same quality, durability and performance, may be proposed for use on this project subject to the approval of the Owner's Representative.

2.2 OWNER FURNISHED EQUIPMENT

A. Equipment provided by the Owner will be designed in the specification and equipment list as "Owner Furnished Equipment" or “Customer Furnished Equipment or "CFE" on A/V drawings in the equipment schedule.

2.3 RELATED WORK SPECIFIED ELSEWHERE:

A. The following systems and equipment are provided under other contracts:
1. Task and general lighting systems, including special low voltage interfaces for remote control by AV equipment.
2. All junction boxes, conduit, and floor boxes.
3. All furniture and millwork unless otherwise noted.
4. All electrical outlets and circuits.
5. All millwork cabinetry for integration with the Contractor provided equipment, unless otherwise described within this specification.
6. All electronic interfaces to building lighting, security and HVAC systems.
7. All IT network voice and data electronics and appliances, unless otherwise described within this specification.

2.4 SYSTEM FUNCTIONAL REQUIREMENTS

A. General Description:

The renovation of Smithsonian Freer/Sackler/AFA/Quad ESS Modernization includes multiple spaces that will receive updated audiovisual technology. This project includes interior updates to all floors. The AV requirements have been divided into the following room types based on their functionality requirements:

Sub-System 1 – Security Control Room

Sub-System 2 – Classrooms

B. Sub-System 1 – Security Control Room

1. Video Wall VASS workstations
   a. Four (4) DisplayPort outputs per workstation
   b. Approved solution (or approved equivalent):
      1) Provided by Division 280513.10 specifications

2. Rack mount for Video Wall VASS workstations
   a. Approved solution (or approved equivalent):
      1) Provided by Division 280513.10 specifications

3. Video Wall Security Workstation
   a. Four (4) DisplayPort outputs per workstation
   b. Approved solution (or approved equivalent):
      1) Provided by Division 280513.10 specifications

4. Fire Alarm Workstation
   a. 24” UL Listed display
   b. UL listed keyboard
   c. UL listed mouse
   d. Min. two HDMI, DVI, or DisplayPort outputs
   e. OFE (Government Furnished/Contractor Installed)

5. Security workstation
   a. Min. one HDMI, DVI, or DisplayPort output
   b. OFE (Government Furnished/Contractor Installed)

6. Rack shelf
   a. Used for Fire Alarm workstation, Fire Alarm display, and Security workstation, one each.
   b. 1RU
   c. Adjustable Telescoping rack shelf
   d. Supports depth from 16" to 26" from front to rear rack rail
   e. 16-guage steel
   f. Black power coat
   g. Supports 500 lbs
   h. Approved solution (or approved equivalent):
      1) Middle Atlantic VSA-1626

7. DisplayPort (DP) to HDMI Adapter for Video Wall VASS workstation
   a. 6-inch adapter cable
   b. Provides active conversion of DisplayPort signals to HDMI
   c. Supports resolutions up to 4K/60 @ 4:4:4 with data rates up to 18 Gbps
   d. Complies with VESA Interoperability Guidelines
   e. HDCP compliant
   f. Approved solution (or approved equivalent):
      1) Extron DPM-HDF/0.5 4K PLUS (26-713-01) (Quantity 16)

8. HDMI Distribution Amplifier

a. Two Output HDMI Distribution Amplifier
b. Supports computer and video resolutions up to 4K/60 @ 4:4:4
c. Supported HDMI 2.0b specification features include data rates up to 18 Gbps, HDR, Deep Color up to 12-bit, 3D, HD lossless audio formats, and CEC control
d. HDCP 2.2 compliant
e. Automatic input cable equalization
f. EDID Minder® automatically manages EDID communication between connected devices
g. Key Minder® continuously verifies HDCP compliance
h. 1RU rack shelf kit
i. Approved solution (or approved equivalent):
    1) Extron DA2 HD 4K PLUS (60-1607-0) (Quantity 4)
    2) Extron RSU 126 (60-190-10)

9. IP KVM for Fire Alarm Workstation
    a. HDMI input with loop output
    b. High Performance
    c. 4K (3840x2160< up to 30 frames per second with 4:2:2 color or HD (1920 x 1080) up to 60 frames per second with 4:4:4: color
    d. AES 128 or 256-bit encryption
    e. Configurable security banner
    f. User authentication options
    g. Local Authentication with users, groups, and permission
    h. LDAP
    i. Active Directory
    j. Java-Free access
    k. Supports up to 8 simultaneous sessions
    l. Approved solution (or approved equivalent)
        1) Raritan Dominion KX IV-101 (DKX4-101)

10. AV Matrix Switch
    a. 8 HDMI Inputs
    b. 8 HDMI outputs
    c. Supports video resolutions up to and including 4K/60 (3840x 2160P/60)
    d. Supports 4:4:4 color space
    e. Supports HDMI 2.0b with data rates up to 18 Gbps
    f. Deep Color up to 12-bit
    g. HDCP 2.3 compliant
    h. EDID Minder
    i. HDCP Key Minder
    j. RS232 and Ethernet control
    k. Approved solution (or approved equivalent):
        1) Extron DXP 88 HD 4K PLUS (60-1495-21)

11. Active video over fiber extender cables
    a. 75’ (22.8m
    b. Supports data rates up to 18 Gbps, video resolutions up to 4K/60 @ 4:4:4, and HDR
    c. Supports EDID, HDCP, and CEC
    d. 4K/60 verified
    e. Flexible, ultra-thin 0.16” (4 mm) diameter cable

f. Plenum, NEC CMP-rated cable
g. No external power is needed
h. Highly resistant to EMI/RFI interference
i. Approved solution (or approved equivalent):
    1) Extron HD Pro P/75 (26-726-75)

12. Displays
    a. Video Wall Displays
    b. Six (6) displays wide by three (3) displays high, 18 total displays
    c. 43” Diagonal
    d. 4K UHD (3840 x 2160 Native) display
    e. Min. 500 nits
    f. Narrow bezel
    g. Commercial/Professional-Grade
    h. HDMI input
    i. Ethernet and RS232 control
    j. Rated for 24x7 operation
    k. 235W power consumption
    l. 3-year manufacturer warranty
    m. Approved solutions (or approved equivalent):
        1) NEC MA431

13. Video Wall Calibration Kit
    a. Software used to match multiple displays in color and brightness
    b. Includes Display Wall Calibrator software application license
    c. Works on Windows 10 operating systems
    d. MDSV USB Sensor 3 colorimeter tool included
    e. Approved solution (or approved equivalent):
        1) NEC KT-LFC-CC2

14. Video Wall Calibration Laptop
    a. Windows 10 Pro 64Bit or newer
    b. Intel i5
    c. 8GB (or larger) memory
    d. 14” (or larger) screen
    e. 256GB (or larger) hard drive
    f. Approved solution (or approved equivalent):
        1) HP 4L1Q8UT#ABA or 28K93UT#ABA

15. Drawer
    a. 2-Space (2RU) drawer
    b. Used to store video wall calibration laptop and calibration kit
    c. Approved solution (or approved equivalent):
        1) Middle Atlantic D2

16. Video Wall Display Mounts
    a. Video Wall Landscape Mounting System with Rails
    b. Supports 43”-46” displays
    c. Hang units on a single strut channel for quick row leveling
    d. Vertical measurement is simply the height of the display to the next rail
    e. Compatible with most 1-5/8" sizes of channel strut

f. Tool-free latching secures displays
g. Height adjustment ±1" on each interface
h. Tilt adjustment at single pivot point, protects displays from twisting
i. Depth can be set between 4" and 7.4" from the wall, providing a range of "home positions" ideal for recessed installations
j. Both sides adjust independently, compensating for imperfections in the wall
k. Walls can be out of alignment by up to 2" (horizontally)
l. 3 levels of lateral adjustment
m. Mount left/right along rail
n. Interface left/right along mount
o. Lock in lateral guide for fine-tune adjustment using turn knobs, protecting screens from potential collisions
p. Cord release system gently and remotely pops any screen out for easy access and can be extended 13.4" for service
q. Protects displays by not requiring an aggressive push to release/pop-out
r. The 10' (304.8 cm) cord can be set up to pull for release from any 90 degree angle
s. Kickstand provides 20 degrees of bottom tilt access
t. Rigid frame keeps displays where you set them, even after extending for service
u. Adjustable home depth position locks screens in place to maintain alignment despite accidental bumps/pushes
v. Video Wall Strut Channel
w. Side Cover Kit
x. Approved solution (or approved equivalent):
    1) Chief (Legrand AV) LVSXU (One per display)
    2) Chief (Legrand AV) CSA100 (One per display)
    3) Chief (Legrand AV) CSACK06B
    4) 1-5/8" channel strut

17. AV Central Controller
    a. Audiovisual Controller
    b. 1 GB SDRAM
    c. 8 GB Flash
    d. One bidirectional RS-232/RS-422/RS-485 serial ports with hardware and software handshaking
    e. One bidirectional RS-232 serial ports with software handshaking
    f. One IR/Serial ports for one-way control of external devices
    g. Two relays for controlling room functions
    h. Approved solution (or approved equivalent):
        1) Extron IPCP Pro 250xi (60-1911-01)

18. AV Touch Panels
    a. 7” tabletop Touch Panel
    b. 1024x600 resolution and 24-bit color depth
    c. Corning Gorilla Glass screen
    d. Power over Ethernet provides power and communication over a single Ethernet cable
    e. Light sensor adjusts screen brightness as the ambient room lighting changes
    f. Color Black
    g. Approved solution (or approved equivalent):
        1) Extron TLP Pro 725T (60-1562-02)

19. KVM console with integrated KVM switch
    a. Supports video resolutions up to 1920 x 1080
    b. 8-Port 1U Rack-Mount Console HDMI KVM Switch
    c. 17 in. LCD
    d. IP Remote Access
    e. Occupies just 1U of space in a rack-mountable, dual-rail drawer
    f. Supports video resolutions up to 1920 x 1080
    g. Approved solution (or approved equivalent)
        1) Middle Atlantic RM-KB-LCD17KVMHD

20. AV Network Switch
    a. 52-Port Stackable Gigabit PoE+ L2/L3 Managed Switch
    b. 48 Gigabit 802.3af/at PoE+ (740W Power Budget)
    c. Four 10-Gigabit SFP+ ports
    d. 176 Gbps Switching Capacity
    e. Full Layer 2/3 Support
    f. 802.1Q VLAN (with Trunking)
    g. 740W PoE power budget
    h. 3-year Limited Warranty
    i. Approved Solution (or approved equivalent)
        1) Luxul SW-610-48P-F

21. Equipment rack
    a. Provided by Division 271116.10

22. Vertical power strip, two per rack
    a. Provided by Division 271116.10

23. Wall mounted Digital Clock
    a. 5 Zones
    b. Time Display 1.8”
    c. Label Display 1.2”
    d. 90.25” wide by 7.25” high by 3.25” deep
    e. Ethernet interface
    f. User changeable multi-color dot matrix LEDs
    g. Oven Controlled Crystal Oscillator (OCXO) accurate to 0.6 seconds per year or 1 second over 20 years
    h. 120VAC
    i. IR remoted included
    j. Approved solution (or approved equivalent):
        1) BRG Precision 7710E

24. SI LAN PC (Located in console bottom)
    a. OFE

25. PACS Workstation (Located in console bottom)
    a. Provided by division 280513.10 specifications

26. 4x1 Keyboard Mouse (KM) switch
    a. Switches a wired USB keyboard, wired USB mount, 1/8” headphones, and 1/8” microphone between four computers.

b. Switching between computers using cursor navigation, front push buttons or optional (not included) remote control
c. Cursor navigation allows the user to switch between computers simply by moving the mouse cursor from one display monitor to another. Both audio and keyboard follow the cursor from one customer to the next with zero delay
d. Approved solution (or approved equivalent):
1) Vertiv (Avocent) SVKM140-001
2) Vertiv (Avocent) 6ft CBL0134 (Two per switch)

27. Workstation displays
a. 22” Narrow Bezel desktop monitor
b. Integrated speakers
c. LED backlighting
d. 250 nits
e. 1920 x 1080 native resolution
f. 16 x 9 aspect ratio
g. 100 x 100 VESA mounting pattern
h. DisplayPort, HDMI, and VGA inputs
i. 12’ DisplayPort to DisplayPort cable
j. Approved solution (or approved equivalent):
1) NEC E221N-BK
2) Extron DisplayPort Ultra/12 12' (26-691-12)

28. Technical consoles
a. Provided by Division 285119

C. Sub-system 2 - Classrooms
1. Displays
a. Government Provided and Government Installed

2. Display mounts
a. Government Provided and Government Installed

3. Display blocking, pathways, and electrical
a. Contractor Provided

PART 3 - EXECUTION

3.1 GENERAL

A. Installation shall include the delivery, unloading, setting in place, fastening to walls, floors, ceilings, counters, or other structures where required, interconnecting wiring of the system components, equipment alignment and adjustment, and all other work whether or not expressly required herein which is necessary to result in complete operational systems.

B. All installation practices shall be in accordance with, but not limited to, the general design and construction requirements of the Owner, the general requirements of divisions 01 and 27 and all contract specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of National, State, and Local

authorities having jurisdiction. Before commencing work, the Contractor shall familiarize himself with all of these requirements.

C. If, in the opinion of the Contractor, an installation practice is desired or required, which is contrary to these specifications or drawings, a written request for modification shall be made to the Owner. Modifications shall not commence without written approval from the Owner.

D. During the installation, and up to the date of final acceptance, the Contractor shall be under obligation to protect his finished and unfinished work against damage and loss. In the event of such damage or loss, Contractor shall replace or repair such work at no cost to the Owner.

3.2 SYSTEM INTERCONNECTIONS

A. The functional interconnections of the audio, video systems shall be as detailed on drawings.

B. The Contractor shall provide all interconnection cable, connectors, terminal strips, Patch panels, faceplates, wireway, flexible conduit, etc., to facilitate the audiovisual systems as detailed within these specifications and drawings.

C. The conduit and power system are detailed in the Electrical Engineer's drawings.

D. The telecommunications wiring and network is detailed on the telecommunication engineer’s drawings.

E. Details for special mounting conditions and millwork design are detailed on the Architect’s drawings.

3.3 SHOP DRAWING REQUIREMENTS

A. Equipment blocks shall include the following information:

B. Unique device name (E.G. SPK.C1400.01)

C. Every device to be installed

D. Inputs (destinations) are shown on the left side of the equipment block.

E. Outputs (sources) are shown on the right side of the equipment block.

F. Bi-direction ports, such as serial control or Ethernet, can be shown on either side of the block with the following exceptions.

1. Uplink ports on network switches are always shown on the left side of the equipment block.
2. Access ports on network switches are always shown on the right side of the equipment block.
3. Network ports on access devices (computers, touch panels, etc.) are always shown on the left side of the equipment block.

4. The serial port on a controller devices, such as an AV central controllers or wall plates with integrated controller, are always shown on the right side of equipment block.
5. The serial port on a controlled devices, such as a display, projector, VTC codec, DSP, are always shown on the left side of the equipment block.

G. With only a few exceptions such as 4-wire analog intercom, outputs can only connect to inputs. Inputs cannot connect to inputs. Outputs cannot connect to outputs.

H. While the inputs and outputs (Video, audio, control, and data) connectors on a specific device may be spread across multiple drawings, the same physical connector cannot be shown more than once in the drawing package for a specific device.

I. Cable feathers or flags that connect devices on different drawings require the unique identifier and port the cable connects to on the opposite device and drawing number of the opposite feather/flag.

J. Cable feathers or flags that connect devices on the same drawings do not require the drawing number of the opposite feather/flag, but still require the unique identifier and port the cable connects to on the opposite device.

3.4 EQUIPMENT LAYOUT

A. The equipment and infrastructure to support the equipment for each area shall be detailed on the drawings.

3.5 PHYSICAL INSTALLATION:

A. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and supports shall be adequate to support their loads with a safety factor of at least five. All boxes, equipment, etc., shall be secured plumb and square. In the installation of equipment and cable, consideration shall be given not only to operational efficiency, but also to overall aesthetic factors.

3.6 CABLE INSTALLATION

A. All cables, regardless of length, shall be marked with a wrap-around cable label at both ends. All cable labels are to include a unique cable number, source equipment unique name and port information, and destination equipment unique name and port information. There shall be no unmarked cables at any place in the system. Text on all cable labels shall correspond with the line drawings and cable run sheets. Cable label standards and material must be approved by the Owner and AV Consultant prior to installation. All labels are to be computer generated using either laser or thermal generated printers. No hand written labels will be accepted and must be replaced prior to the testing and acceptance of the room. All inter-rack cabling shall be neatly strapped, dressed, and adequately supported.

B. Terminal blocks, boards, strips, or connectors, shall be furnished for all cables which interface with racks, cabinets, consoles, or equipment modules. This includes all copper and fiber tie cables that connect the TR to the A/V racks, credenzas, and lecterns inside the A/V rooms.

C. No audio cables shall be terminated directly to the audio patch panel jacks. Each audio patch panel shall be furnished with an audio terminal block and all audio cables to and from the audio patch panel shall terminate on this block.

D. All cables shall be grouped according to the signals being carried. In order to reduce signal contamination, separate groups shall be formed for the following cables:

1. Electrical power
2. Control & Data Networking
3. Video
4. Audio

E. As a general practice, all power cables, control cables and high level cables shall be run on the left side of an equipment rack as viewed from the rear. All other cables shall be run on the right side of an equipment rack, as viewed from the rear.

F. For this project, the Owner requires the Contractor to use plenum rated cables where home run conduits are NOT provided for the audiovisual system or above finished ceilings. Unless otherwise called for in these specifications and drawings, the following cables, or their approved riser equivalents, shall be used in these systems:

1.	AUDIO (MIC/LINE)	BELDEN 9451P (Black)
2.	SPEAKER UP TO 300FT	BELDEN 6200UE (Natural/White)
3.	SPEAKER RUNS 300FT+	BELDEN 6100UE (Natural/White)
4.	RS232	BELDEN 9451P (Red)
5.	CONTACT CLOSURE	BELDEN 9451P (Red)
6.	CATV/MATV	BELDEN 1189AP (White)
7.	NETWORK	REFER TO 27 1500 SPECS
8.	HDMI/DVI/DISPLAYPORT	EXTRON ULTRA SERIES

G. All AV Contractor terminated cables shall be cut to the length dictated by the run. The appropriate length premade cables, such as HDMI and USB, should be used as excessive extra cable is not acceptable to the Owner. No splices or couplers shall be permitted in any pull boxes without prior written permission of the Owner. For equipment mounted in drawers or on slides, the interconnecting cables shall be provided with a service loop of appropriate length. No cable shall be installed with a bend radius less than that recommended by the cable manufacturer.

H. All data copper cabling shall be 4-pair, UTP, plenum rated CAT-6A cable unless otherwise noted. All CAT-6A cables shall be terminated on CAT-6A rated RJ-45 connector and/or jacks.

I. Provide certification documentation that the Contractor has tested their installed wiring and connectivity per industry standards, specifically telecommunications cabling e.g. Category 6A UTP and optical fiber cabling. This certification documentation shall include all cables listed on the drawings and/or cable run list.

J. All terminations and cabling shall be neatly dressed.

K. Properly secure fiber, category cable (cat6a), and digital video cables (HDMI, DisplayPort, DVI, Coax, etc.) using Velcro (hook and loop). Plastic or nylon wire ties are not permitted on fiber, category cable, and digital video cables.

L. Properly secure audio and serial control cables using Velcro (hook and loop) or nylon wire ties.

M. All 1.8 (3.5 mm) stereo audio cables shall be factory premade (not field terminated) to the greatest extent possible.

3.7 CONNECTION PLATE RECEPTACLES:

Unless otherwise detailed herein, the following types of panel receptacles shall be used on all connection boxes, panels, plates, and wireways:

A. Video - BNC type. Wall plate inputs and outputs shall be female connectors. Portable cabling shall include male connectors at each end and shall be rated for 3 Gbps.

B. Control RS232 - SubD9 type. Wall plate inputs and outputs shall be female connectors. Portable cabling shall include male connectors at each end. RS232 signal cables to be kept to 50 ft or less.

C. VGA or analog PC video: Sub-D style, 15-pin type. Wall plate connectors shall always be female. Cabling shall be male connectors on each end.

D. DVI. Wall plate connectors shall always be female. Cabling shall be male connectors on each end.

E. HDMI. Wall plate connectors shall always be female. Cabling shall be male connectors on each end.

F. DisplayPort. Wall plate connectors shall always be female. Cabling shall be male connectors on each end.

3.8 PATCH PANELS

A. Assignments: All patch panels shall be wired so that signal "sources" (outputs from) appear on the upper row of a row pair; and all "loads" (inputs to) appear on the lower row of a row pair.

B. Patch Panel Designation Strips: All audio and video patch panel designation strips shall utilize alphanumeric identifications and descriptive information. The jack position in each horizontal row shall be numbered sequentially from left to right. The horizontal jack rows shall be lettered sequentially from top to bottom. The alphanumeric identification of each jack shall be included on the functional block drawings, as well as on reproductions of these drawings, which shall be mounted in an appropriate location near the patch bays. All patch panel labels shall be printed on card stock using a laser printer. No hand written labels are acceptance to the Owner and must be replaced prior to Testing and Acceptance.

3.9 GROUNDING PROCEDURES

A. In order to minimize problems resulting from improper grounding, and to achieve maximum signal-to-noise ratios, the following grounding procedures shall be adhered to:

1. System Grounds: A single primary "system ground" shall be established for the systems in each particular area. All grounding conductors in that area shall connect to this primary system ground. The system ground shall be provided in the audio equipment rack for the area and shall consist of a copper bar of sufficient size to accommodate all secondary ground conductors. A copper conductor, having a maximum of 0.1 Ohms total resistance, shall connect the primary system ground bar to the nearest metallic electrical conduit of at least 5.08 cm (2 in) in diameter. The Contractor shall be responsible for determining if the metallic conduit is properly electrically bonded to the building ground system.
2. Secondary System Grounding Conductors shall be provided from all racks, audio consoles and ungrounded audio equipment in each area, to the primary system grounding point for the area. Each of these grounding conductors shall have a maximum of 0.1 Ohms total resistance. Under no conditions shall the AC neutral conductor, either in the power panel or in a receptacle outlet, be used for a system ground.
3. Audio Cable Shields: All balanced audio cables shall be shielded and shall be grounded at only one point, the signal “source” (output from) connector. The ground is to be lifted (not connected) at the signal “load” (input to) connector. For unbalanced audio cables, the shield is to be connected to the ground at the signal “source” (output from) connector and lifted at the signal “load” (input to) connector. The shield is to be connected at both ends for microphone level signals. Unbalanced audio signals are susceptible to noise and shall be kept to 6.096 m (20 ft) or less.
4. Video Receptacles: All video receptacles that are provided and installed by the Contractor shall be insulated from the mounting panel, outlet box, or wireway. Unless otherwise detailed herein, this shall be accomplished by using insulated from panel type receptacles.
5. General: Because of the great number of possible variations in grounding systems, it shall be the responsibility of the Contractor to follow good engineering practice as outlined by EIA/TIA and recommended by BICSI and INFOCOMM. Deviation from these practices is permitted only when necessary to minimize crosstalk and to maximize signal to noise ratios in the audio, video, and control systems.

3.10 PERFORMANCE TEST SIGNAL PATHS:

A. Test all video and audio signal paths.

1. Audio: From all source inputs (for microphones, audio tape units, video tape units, etc.) through all mixers, audio distribution amplifiers (ADA), switchers, etc., to all signal destinations.
2. Video: From all source inputs through all processors, switchers, etc., to all signal destinations.
3. The delineation of the above signal paths shall not exempt the Contractor from the responsibility of checking all paths and outlets for appropriate compliance with the Performance Standards.

3.11 CONTRACTOR SYSTEM CHECKOUT

Before Acceptance Tests are scheduled, the Contractor shall perform his own system checkout. He shall furnish all required test equipment and shall perform all work necessary to determine and/or modify performance of the system to meet the requirements of this specification. This test and commissioning procedure shall be fully documented and include the following:

A. Test all audio and video systems for compliance with the Performance Standards.

B. Check all control functions, from all controlling devices to all controlled devices, for proper operation.

C. Adjust, balance and align all equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for all level controls and record these settings in the "System Operation and Maintenance Manual.

1. Check all optical projection images for average light level, light fall off, image alignment and size to comply with the Performance Standards and specification drawings. Check to determine that all projectors, projector bases, carts, tables and mirrors are rigid and vibration-less in operation.
2. Maintain documentation of all performance tests for reference by the Owner during the System Acceptance Tests.

3.12 SYSTEM ACCEPTANCE TESTS

A. Prior to Owner Acceptance, the Contractor is responsible for demonstrating that the entire scope of work defined is complete and fully functional per the scope of this specification and drawings, as well as any additional approved Change Order directives.

B. Prior to conducting the Proof of Performance for the benefit of the Owner and the Owner’s representatives, the Contractor must complete their own quality review and complete all system commissioning and programming procedures. The Contractor must also provide a red-lined set of drawings and documentation.

C. For the Proof of Performance (Acceptance Test Procedure), the Contractor is responsible for notifying the General Contractor and Owner at least two weeks in advance of a scheduled session. At least one week prior to the Testing and Acceptance, the AV Contractor is to provide the Test Plan for review and approval of the Owner and AV Contractor. At time of Proof of Performance session, the Contractor is responsible for providing all test equipment and test materials (blank & pre-recorded video tape, blank and prerecorded audio tape, Audio CD, high resolution test signal generators, etc.). The System Acceptance Tests will be supervised by the Owner and AV Consultant and will consist of the following:

1. A physical inventory will be taken of all equipment on site and will be compared to equipment lists in the contract documents. This physical inventory must be provided to the Owner, in advance of the scheduled Acceptance Test Procedure, in electronic spreadsheet format using Microsoft Excel software application.
2. The Contractor shall document and report the results of all testing data. The testing data shall be provided to the Owner, and certified by the Contractor.
3. The operation of all system equipment shall be demonstrated by the Contractor.
4. Both subjective and objective tests will be required by the Owner to determine compliance with the specifications. The Contractor shall be responsible for providing test equipment for these tests.
5. All “red-line” shop drawings, run sheets, manuals, and other required documents. Two complete sets of these documents shall be delivered to the Owner at this time.
6. In the event further adjustment is required, or defective equipment must be repaired or replaced, tests may be suspended or continued at the option of the Owner.

3.13 RECOGNITION:

A. All installations shall bear the following identification plate, supplied by this contractor, permanently mounted on the front of the equipment rack/credenza, positioned at the top:

B. SYSTEM FABRICATED & DESIGNED BY:

1. GHD Logo
2. 14585 Avion Parkway
3. Suite 150
4. Chantilly, VA 20151
5. (571) 325-5000
6. www.ghd.com

C. SYSTEM FABRICATED & INSTALLED BY:

1. Contractor’s Logo
2. Contractor’s street address
3. Contractor’s city, state and zip code
4. Contractor’s contact phone number
5. Contractor’s web page

3.14 CONTROL SYSTEM PROGRAMMING:

A. Video routing to top six displays
B. Individual display on/off (show a grid six wide by three high)
C. All displays on/off
D. Video wall color calibration

END OF SECTION 274116

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SECTION 280500.10 – COMMON WORK RESULTS FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide the electronic security system (ESS) in accordance with the drawings, specifications, and referenced publications.

B. Perform all work, products, systems integration, engineering, and design work required for the project in order to ensure complete and fully operational systems and proper installation of equipment. Provide calculations and analysis to support design and engineering decisions as specified in submittals. Provide and pay all labor, materials, and equipment, sales and gross receipts and other taxes. Secure and pay for plan check fees, permits, other fees, and licenses necessary for the execution of work as applicable for the project. Give required notices; comply with codes, ordinances, regulations, and other legal requirements of public authorities, which bear on the performance of work.

C. Provide an ESS, installed, programmed, configured, documented, and tested. The security system includes but is not limited to: access control, intrusion detection, duress alarms, elevator control interface, video surveillance and assessment, video recording and storage, delayed egress, intercommunication system, fire alarm interface, equipment cabinetry, and uninterruptible power supplies (UPS) interface.

D. The work includes the procurement and installation of electrical wire and cables, the installation and testing of all system components. Inspection, testing, demonstration, and acceptance of equipment, software, materials, installation, documentation, and workmanship, shall be as specified herein. Provide all associated installation support, including the provision of primary electrical input power circuits.

E. Provide repair service replacement parts and on-site service during the warranty period. Guarantee all parts and labor for a term of one (1) year, unless dictated otherwise in this specification from the acceptance date of the system as described in specification 280800.10. The Contractor is responsible for all equipment, software, firmware, licensing, shipping, transportation charges, and expenses associated with the service of the system for one (1) year.

F. Operator training is not required.

1.2 SUMMARY

A. This specification provides general requirements for the overall electronic security system (ESS) applicable to all projects.

1.3 RELATED DOCUMENTS

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

B. This Specification is the base document for electronic security systems. Use the following specification sections in conjunction to provide a complete and fully integrated security management system.

1. 27 0526.10 – Grounding and Bonding for Security Systems
2. 27 0528.10 – Pathways for Security Systems
3. 27 0536.10 – Cable Trays for Security Systems
4. 27 0544.10 – Sleeves and Sleeve Seals for Security Pathways and Cabling
5. 27 1116.10 – Security Cabinets, Racks, Frames, and Enclosures
6. 27 1300.10 – Security Backbone Cabling
7. 27 1500.10 – Security Horizontal Cabling
8. 28 0500.10 – Common Work Results for Electronic Security
9. 28 0507.10 – Power Sources for Electronic Security
10. 28 0513.10 – Servers, Workstations and Storage for Electronic Security
11. 28 0531.10 – Communications Equipment for Electronic Security
12. 28 0800.10 – Commissioning of Electronic Security
13. 28 1000 – Access Control
14. 28 1515 – Electrified Locking Devices & Accessories
15. 28 1523 – Intercom Entry Systems
16. 28 1525 – Electronic Key Management Systems
17. 28 2000 – Video
18. 28 3100 – Intrusion Detection
19. 28 5119 – Control Room and Monitoring Equipment

C. Requirements of Specification 280500.10 take precedence over Division 01 System Acceptance requirements.

D. Related Sections include the following:

1. Division 01
2. Division 08
    a. Coordinate Division 8 and 28 requirements.
3. Division 12
    a. Coordinate case mounted security sensors and equipment.
4. Division 23
    a. Coordinate installation of the Light Control Equipment, Radio, and Elevator Status Equipment installed in the Security Monitoring Console. Provide dedicated Liebert Cooling Systems (or approved equivalent) and controls, for each Security Monitoring Control and Equipment room.
5. Division 26
    a. Provide dedicated Emergency Electrical Power (120 VAC) circuits as required to provide full system functionality.
6. Division 27
    a. Shared pathways
    b. Security Cabling
    c. Grounding and Bonding System

1.4 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI INCITS 92 (1980, R 2003), Data Encryption Standard
2. ANSI/TIA-568.0-D, Rev D (9/2015+Edit:12/2015) , Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568.1-D, Rev D (9/2015), Commercial Building Telecommunications Infrastructure Standard
4. ANSI/TIA-568-C.2, Rev C (8/2009+A1:6/2016), Balanced Twisted-Pair Telecommunications Cabling And Components Standards
5. ANSI/TIA-568-C.3, Rev C (6/2008+A1:10/2011), Optical Fiber Cabling Components Standard
6. ANSI/TIA-568-C.4, Rev C (7/2011), Broadband Coaxial Cabling and Components Standard
7. ANSI/TIA-569, REV D (4/2015), Telecommunications Pathways and Spaces
8. ANSI/TIA-606, Rev B (6/2012+A1:12/2015), Administration Standard for the Telecommunications Infrastructure
9. ANSI/TIA-607, Rev C (11/2015), Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
10. ANSI/TIA/EIA 492AAAB Rev B (11/2009), Detail Specification for 50µm Core Diameter / 125µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers.
11. ANSI/TIA/EIA-526-14 Revision C (4/2015), Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; Modification of IEC 61280-4-1 edition 2, Fiber-Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant-Multimode Attenuation Measurement
12. ANSI/SIA CP-01-2014, Control Panel Standard - Features for False Alarm Reduction

B. ASTM International (ASTM)

1. ASTM A153/A153M-16, Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
2. ASTM B3-13, Standard Specification for Soft or Annealed Copper Wire
3. ASTM B32-08 (2014), Standard Specification for Solder Metal
4. ASTM C1107/C1107M-14a, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
5. ASTM D709-16, Standard Specification for Laminated Thermosetting Materials
6. ASTM E84-16, Standard Test Method for Surface Burning Characteristics of Building Materials

C. Federal Information Processing Standards (FIPS):

1. FIPS PUB 201 2nd Edition (8/1/2013), Personal Identity Verification (PIV) of Federal Employees and Contractors

D. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE Std 100 (2000), The Authoritative Dictionary of IEEE Standards Terms
2. IEEE 81, 2012 Edition (12/2012), Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

3. IEEE 142, 2007 Edition (11/2007), Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book (Color Book Series)
4. IEEE C2 National Electrical Safety Code (NESC), 2017 Edition
5. IEEE C62.41.1, 2002 Edition (11/2002), RN: (12/2008), Guide on Surges Environment in Low Voltage (1000 V and Less) AC Power Circuits
6. IEEE C62.41.2, 2002 Edition (11/2002), CRGD: (12/2012), Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

E. International Organization for Standardization (ISO)

1. ISO 7810, 2003 Edition, A2 (01/2012), Identification Cards – Physical Characteristics

F. National Electrical Contractors Association (NECA)

1. NECA 1 2015 Edition (1-2015), Standard for Good Workmanship in Electrical Construction

G. National Electrical Manufacturers Association (NEMA)

1. NEMA 250, 2014 Edition (1/2014), Enclosures for Electrical Equipment (1000 Volts Maximum)
2. NEMA ICS 1 (2000; R 2015), Industrial Control and Systems: General Requirements
3. NEMA ICS 2 (2000; Errata 3/2008), Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated 600 Volts
4. NEMA ICS 6 93rd Edition (1993; R 2011), Industrial Control and Systems: Enclosures

H. National Fire Protection Association (NFPA)

1. NFPA 70 2019 Edition (2019), National Electrical Code
2. NFPA 72 2019 Edition (2019), National Fire Alarm and Signaling Code.
3. NFPA 101 2018 Editon (2018), Life Safety Code
4. NFPA 262 2019 Edition (2019), Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
5. NFPA 730 2020 Edition (1/2020), Guide for Premises Security
6. NFPA 731 2020 Edition (1/2020), Standard for the Installation of Electronic Premises Security Systems

I. National Institute of Standards and Technology (NIST)

1. PIV Card Specifications:
   a. SP 800-73-2 (9/2008), Interfaces for Personal Identity Verification
   b. NISTIR 7284 (2006), Personal Identity Verification Card Management Report
   c. SP 800-76-2 (7/2013), Biometric Data Specification for Personal Identity Verification
   d. SP 800-78-4 (5/2015), Cryptographic Algorithms and Key Sizes for Personal Identity Verification
   e. SP 800-73-4 (4/2016), PIV Card Application and Middleware Interface Test Guidelines
2. PIV Card and Middleware Conformance Testing:
   a. SP 800-85B (2006), PIV Data Model Conformance Test Guidelines
3. PIV Accreditation:

a. SP 800-96 (2006), PIV Card / Reader Interoperability Guidelines

4. Issuing Organizations:
   a. SP 800-87 Rev 1 (4/2008), Codes for the Identification of Federal and Federally-Assisted Organizations
   b. NISTIR 7337 (2006); Personal Identity Verification Demonstration Summary

J. Security Industry Association (SIA)

1. SIA BIO-01-1993.02 (R2000.06), Biometric Vocabulary Standard
2. SIA DC-01-1988 (R2001.04), DCS Computer Interface (CIS-1) Technical Report
3. SIA DC-03-1990.01 (R2003.10), DCS SIA Format Standard
4. SIA DC-07-2001.04, DCS Computer Interface (CIS-2) Standard

K. Telecommunications Industries Association (TIA)

1. TIA-232 Rev F (10/1997; R 12/2012), Interface Between Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary data Exchange
2. EIA/ECA-319 Rev E (12/2005), Cabinets, Racks, Panels, and Associated Equipment
3. TIA-455-3, Rev B (7/2009), Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components
4. TIA-455, Rev C (8/2014), General Requirements for Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
5. TIA-598 Revision D (7/2014), Optical Fiber Cable Color Coding
6. TIA-604-3 Revision B (8/2004; R 1/2014), FOCIS-3 Fiber Optic Connector Intermateability Standard, Type SC and SC-APC
7. TIA-604-1 1996 Edition (3/1996; R 1/2012), Fiber Optic Connector Intermateability Standard

L. Underwriters Laboratories (UL)

1. UL 6 2014 Edition (11/2014), Electrical Rigid Metal Conduit - Steel
2. UL 50 13th Edition (10/2015), Enclosures for Electrical Equipment, Non-Environmental Considerations
3. UL 50E 2nd Edition (10/2015), Enclosures for Electrical Equipment, Environmental Considerations
4. UL 83 15th Edition (3/2014), Thermoplastic-Insulated Wires and Cables
5. UL 294 6th Edition (2/2015), Access Control System Units
6. UL 444 4th Edition (4/2015), Communications Cables
7. UL 464 10th Edition (1/2016), Audible Signaling Devices for Fire Alarm and Signaling Systems, including Accessories
8. UL 467 10th Edition (3/2013), Standard for Safety Grounding and Bonding Equipment
9. UL 497B 4th Edition (12/2012), Protectors for Data Communication and Fire Alarm Circuits
10. UL 609 11th Edition (3/2015), Local Burglar Alarm Units and Systems
11. UL 634 2009 Edition (12/2009; R 3/2015), Connectors and Switches for Use with Burglar-Alarm Systems
12. UL 636 10th Edition (10/2008; R 1/2013), Holdup Alarm Units and Systems
13. UL 639 8th Edition (5/2012), Intrusion Detection Units
14. UL 681 15th Edition (1/2014), Installation and Classification of Burglar and Holdup Alarm Systems

15. UL 796 11th Edition (5/2016), Printed-Wiring Boards
16. UL 797 9th Edition (12/2012), Electrical Metallic Tubing -- Steel
17. UL 827 8th Edition (2/2015), Central Station Alarm Services
18. UL 910 5th Edition (11/1998), Test for Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
19. UL 969 4th Edition (11/2001), Marking and Labeling Systems
20. UL 972 6th Edition (7/2011), Burglary Resisting Glazing Material
21. UL 1037 6th Edition (9/2016), Antitheft Alarms and Devices
22. UL 1076 5th Edition (3/2015), Proprietary Burglar Alarm Units and Systems
23. UL 1424 4th Edition (1/2015), Power-Limited Fire-Alarm Circuits
24. UL 1492 (3/2002; R 7/2013), Audio-Video Products and Accessories
25. UL 1581 4th Edition (8/2016), Reference Standard for Electrical Wires, Cables, and Flexible Cords
26. UL 1610 4th Edition (7/2016), Central-Station Burglar-Alarm Units
27. UL 1635 3rd Edition (1/2012; R 3/2015), Digital Alarm Communicator System Units
28. UL 1638 5th Edition (1/2016), Visible Signaling Devices for Fire Alarm and Signaling Systems, including Accessories
29. UL 1638A 1st Edition (6/2016), Visual Signaling Appliances for General Signaling Use
30. UL 1655 2nd Edition (11/2014; R 11/2014), Community-Antenna Television Cables
31. UL 1660 5th Edition (7/2014), Liquid-Tight Flexible Nonmetallic Conduit
32. UL 1666 5th Edition (6/2012), Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
33. UL 1981 3rd Edition (4/2015). Central Station Automation Systems
34. UL 2050 5th Edition (11/2010), National Industrial Security Systems
35. UL 2196 1st Edition (3/2012), Tests for Fire Resistive Cables

1.5 DEFINITIONS

A. ARA: Area of Rescue Assistance

B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

C. BICSI: Building Industry Consulting Service International

D. Controller: An intelligent peripheral control unit that uses a computer for controlling its operation. Where this term is presented with an initial capital letter, this definition applies.

E. CPU: Central processing unit.

F. Credential: Data assigned to an entity and used to identify that entity.

G. DGP: Data Gathering Panel

H. EMI: Electromagnetic interference.

I. EMT: Electric Metallic Tubing

J. ESS: Electronic Security System

K. GFI: Ground fault interrupter.

L. Identifier: A credential card, keypad personal identification number or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

M. I/O: Input/Output.

N. INC: Intelligent Network Controller

O. Intrusion Zone (IZ): A space or area for which an intrusion must be detected and uniquely identified, the sensor or group of sensors assigned to perform the detection, and any interface equipment between sensors and communication link to central-station control unit.

P. LAN: Local area network.

Q. LCD: Liquid-crystal display.

R. LED: Light-emitting diode.

S. LOD: Level of Detail

T. LOE: Level of Effort

U. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

V. M-JPEG: Motion – Joint Photographic Experts Group.

W. MPEG: Moving picture experts group.

X. NEC: National Electrical Code

Y. NECA: National Electrical Contractors Association

Z. NEMA: National Electrical Manufacturers Association

AA. NFPA: National Fire Protection Association

BB. NRTL: Nationally Recognized Testing Laboratory.

CC. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

DD. OPS: Office of Protection Services

EE. OTDR: Optical Time Domain Reflectometer

FF. PACS: Physical Access Control System

GG. PIR: Passive infrared

HH. PIR Rex: Passive Infrared Request to Exit

II. PPSD: Personnel and Physical Security Division (A department within OPS)

JJ. RCDD: Registered Communications Distribution Designer.

KK. RF: Radio frequency.

LL. RFI: Radio-frequency interference.

MM. RIGID: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.

NN. RS-232: An TIA/EIA standard for asynchronous serial data communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

OO. RS-485: An TIA/EIA standard for multipoint communications.

PP. SMS: Security Management System – A SMS is a software that incorporates multiple security subsystems (e.g., access control, intrusion detection, closed circuit television, intercom) into a single platform and graphical user interface.

QQ. Standard Intruder: A person who weighs 100 lb. (45 kg) or more and whose height is 1525 mm (60 in) or more; dressed in standard clothing.

RR. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

SS. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

TT. TDMM: Telecommunications Distribution Methods Manual

UU. TIA: Telecommunications Industry Association

VV. UPS: Uninterruptible Power Supply

WW. UTP: Unshielded Twisted Pair

XX. VASS: Video Assessment and Surveillance System

YY. VPN: Virtual Private Network

ZZ. WAN: Wide Area Network.

AAA. WAV: The digital audio format used in Microsoft Windows.

BBB. Windows: Operating system by Microsoft Corporation.

CCC. Workstation: A PC with software that is configured for specific limited security system functions.

DDD. WYSIWYG: (What You See Is What You Get.) Text and graphics appear on the screen the same as they will print.

1.6 GENERAL ARRANGEMENT OF CONTRACT DOCUMENTS

A. The Contract Documents supplement to this specification indicates approximate locations of equipment. The installation and/or locations of the equipment and devices shall be governed by the intent of the design; specification and Contract Documents, with due regard to actual site conditions, recommendations, ambient factors affecting the equipment and operations in the vicinity. The Contract Documents are diagrammatic and do not reveal all offsets, bends, elbows, components, materials, and other specific elements that may be required for proper installation. If any departure from the contract documents is deemed necessary, or in the event of conflicts, the submit details of such departures or conflicts in writing to the owner or owner's representative for his or her comment and/or approval before initiating work.

B. Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called by all, except if a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Form of Agreement; the Supplemental General Conditions; the Special Conditions; the Specifications with attachments; and the drawings.

1.7 SUBMITTALS

A. General

1. Comply with the Contract Documents and in accordance with this section. Submittals lacking the breath or depth of these requirements will be considered incomplete and rejected. Submissions are considered multidisciplinary and require coordination with applicable divisions to provide a complete and comprehensive submission package. Additional general provisions are as follows:
    a. Schedule submittals to maintain the project schedule. For coordination drawings refer to Division 1 Specification, which outline basic submittal requirements and coordination.
    b. Identify variations from requirements of Contract Documents and state product and system limitations, which may be detrimental to successful performance of the completed work or system.
    c. Submit each package at one (1) time for each review and include components from applicable disciplines (e.g., electrical work, architectural finishes, door hardware, etc.) which are required to produce an accurate and detailed depiction of the project.
    d. Manufacturer's information used for submittal shall have pages with items for approval tagged, items on pages shall be identified, and capacities and performance parameters for review shall be clearly marked through use of an arrow or highlighting. Provide space for COTR and Contractor review stamps.
    e. Drawings shall be in the project specific version of AutoCAD® or REVIT, drawn accurately, and in accordance with Smithsonian Institution CAD and REVIT Standards. FREEHAND SKETCHES OR COPIED VERSIONS OF THE CONSTRUCTION DOCUMENTS WILL NOT BE ACCEPTED. If departures from the drawings are subsequently deemed necessary by the Contractor, submit details of such departures and the reasons thereof in writing to the COTR and the PPSD Security Engineer for approval before initiating work.

f. Submittal Format
   1) Provide one (1) hard-copy of drawings. Make all other submittals as PDF with bookmarks for sections.
   2) Refer to SI Special Conditions Document for drawing format and content requirements.

B. Pre-Installation Submittals

1. Qualifications
   a. The Security Contractor is not allowed on-site until the Owner approves the Qualifications submittal.
   b. Provide Company certifications
      1) Software House
         a) Certified Integrator
   c. Include qualifications and manufacturer's certifications for individuals working on the project including but not limited to:
      1) Software House
         a) CCURE 800/8000
         b) CCURE 9000
      2) American Dynamics
         a) Victor
         b) Video Edge
      3) Vingtor-Stentofon
      4) Cisco
         a) Cisco Certified Network Associate (CCNA)
      5) BICSI
         a) RCDD
   d. Provide project references as outlined in Paragraph 1.11 A "Contractor Qualifications".
2. Product Data
   a. Provide a chart of product data listing the specification section and paragraph number of each product. Annotate if "Provided as Specified" or "Substitution Requested".
   b. Product data sheets organized and bookmarked by Specification Division. Annotate deviations from the design documents and the justification for the change.
   c. Where the words, "or approved equivalent" or like words are used, either furnish the equipment as specified or submit a request for substitution in writing with the make, model, and justification to the COTR and the PPSD Security Engineer for approval.
   d. If the contractor recommends equipment substitution, the contractor is responsible for complete documentation of the reason for the change including price differential and is financially liable for the design time expended by the security consultant to research the substitution.
3. Shop Drawings
   a. Build upon the design documents to reflect current conditions and approved product data. Annotate deviations from the design documents and the justification for the change.
   b. Include wiring diagrams to include but not limited to power supplies, card readers, fire alarm connections, elevator interface, and tamper circuits.

c. Security door schedule coordinated with Division 8 requirements. Include the following information:
   1) Configuration Number
   2) Door Number (Derived from Architectural Drawings)
   3) Floor Plan Sheet Number
   4) Standard Detail Number
   5) Door Description (Derived from Loading Sheets)
   6) Security Point Number (Derived from Loading Sheets)
   7) Door Position or Monitoring Device Type, Make & Model Number
   8) Lock Type, Model Number & Power Input/Draw (standby/active)
   9) Card Reader Type, Make & Model Number
   10) Shunting Device Type, Make & Model Number
   11) Sounder Type, Make & Model Number
   12) Camera Make & Model Number
   13) Misc. devices as required
      a) Delayed Egress Type, Make & Model Number
      b) Intercom Make & Model Number
      c) Electric Transfer Hinge
      d) Electric Pass-through device
   14) Remarks column indicating special notes or door configurations

C. Pre-Programming Submittals

1. Nameplates
2. IP Addressing Scheme
   a. Provide OPS with the quantity of devices requiring IP addresses. OPS will then provide the IP addressing scheme.
3. Loading Sheets
   a. Provide loading sheets for each DGP, including input and output boards for all field panels associated with the project.
   b. OPS-PPSD will provide blank electronic sheets for contractor use.
   c. Provide a spreadsheet for each DGP. Name the spreadsheet with the DGP number (e.g. “Site Name DGP-01.xls”)

D. Pre-Acceptance Testing Submittals

1. OPS-PPSD will provide blank testing forms for contractor to reproduce and fill out during testing.
2. Contractor Field Test
   a. Contractor performs the Contractor Field Test (CFT) of all devices utilizing OPS provided forms and submits test results to OPS-PPSD.
3. Performance Verification Test
   a. Based on the OPS-PPSD approval of the Contractor’s Field Test, the COTR will schedule the PVT with the Contractor and OPS-PPSD.
   b. OPS-PPSD will witness the Contractor conduct the PVT of all devices utilizing the same form as for the CFT.

E. Closeout Submittals

1. Project Redlines

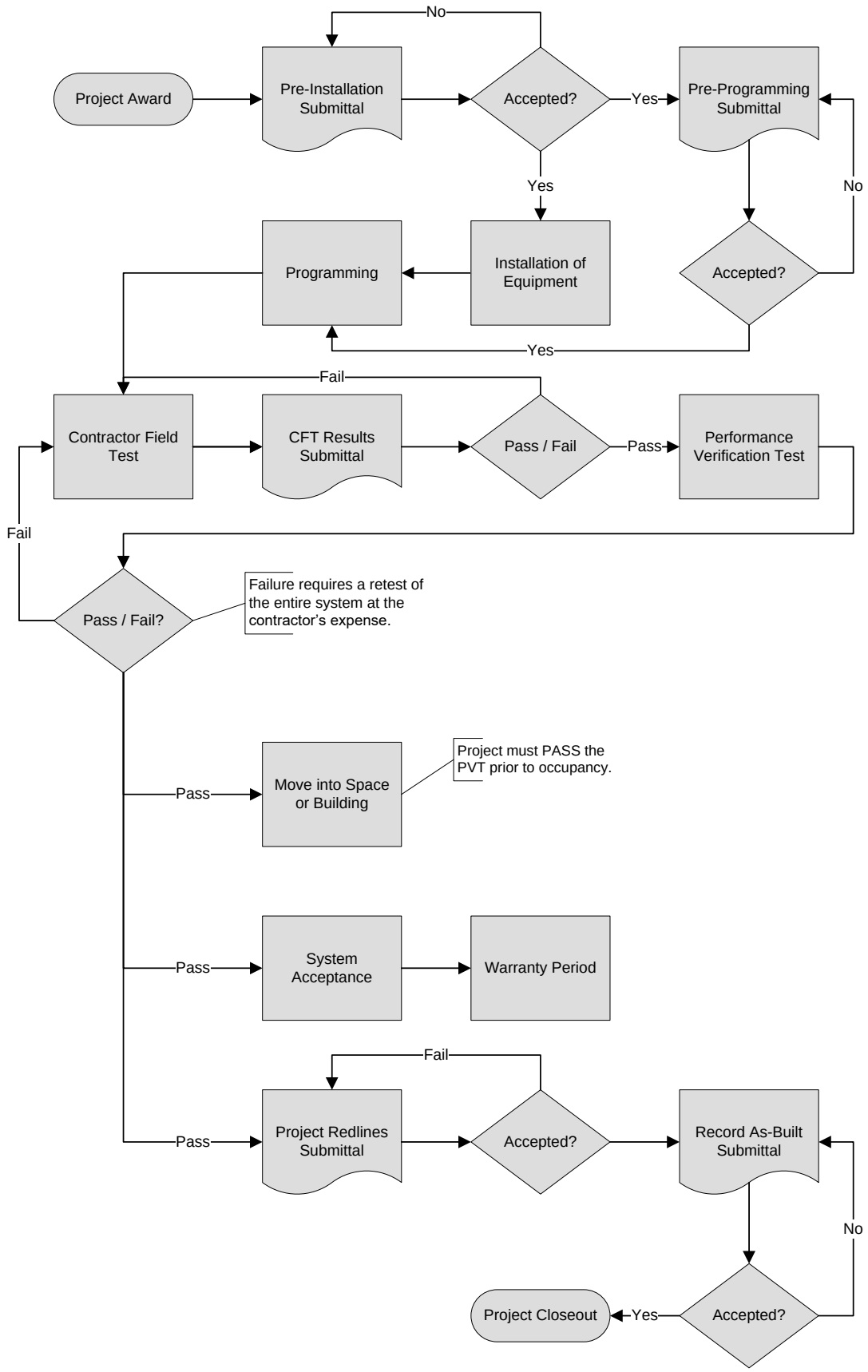
a. Neatly maintain an up-to-date set of construction redlines detailing current location and configuration of the project components.
b. Mark the redline documents with the words 'Master Redlines' on the cover sheet and be maintained by the Contractor in the project office.
c. Field drawings shall be used for data gathering & field changes. These changes shall be made to the master redline documents daily. Field drawings shall not be considered "master redlines".
d. Provide access to redline documents anytime during the project for review and inspection by the COTR or authorized OPS representative.
e. Any project component or assembly that is not installed in strict accordance with the drawings shall be so noted on the drawings.
f. Submit the Master Redline document to the COTR and PPSD Security Engineer for review and approval of all changes or modifications to the documents prior to producing Record Construction Documents. The COTR shall be given a minimum of a thirty (30) day review period to determine the adequacy of the Master Redlines. If the master redlines are found suitable by the COTR and the PPSD Security Engineer, the COTR will initial and date each sheet and turn the redlines over to the Contractor for Record As-Built development.

2. Record Construction Documents (Record As-Built)
   a. The submitted as built documents shall be in editable electronic formats and the ownership of the drawings shall be fully relinquished to the owner.

1.8 PROJECT PROCESS DIAGRAM

A. The ESS Project Process Diagram (below) is provided to identify key consecutive or concurrent tasks and milestones required to ensure the project is completed prior to owner occupancy. Substantial completion means all systems have been fully tested and accepted in writing by OPS. Minor or non-life safety related punch list items may continue through owner occupancy, but shall be resolved within two (2) weeks of official date of occupancy.

B. The contractor is encouraged to utilize the diagram for the development of project schedules, and coordinating submissions.


Project Award
Pre-Installation Submittal
Accepted?
No
Yes
Pre-Programming Submittal
Accepted?
No
Yes
Installation of Equipment
Programming
Yes
Contractor Field Test
CFT Results Submittal
Pass / Fail
Fail
Pass
Performance Verification Test
Fail
Pass / Fail?
Failure requires a retest of the entire system at the contractor's expense.
Pass
Move into Space or Building
Project must PASS the PVT prior to occupancy.
Pass
System Acceptance
Warranty Period
Pass
Project Redlines Submittal
Accepted?
Fail
Record As-Built Submittal
Accepted?
No
Yes
Project Closeout

1.9 COORDINATION

A. Coordinate arrangement, mounting, and support of electronic security equipment:

B. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

C. To provide for ease of disconnecting the equipment with minimum interference to other installations.

D. To allow right of way for piping and conduit installed at required heights.

E. Ensure raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

F. Coordinate the installation of required supporting discipline devices placement and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

G. Coordinate the locations of access panels and doors for electronic security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

H. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."."

1.10 QUALITY ASSURANCE

A. Contractor Qualifications

1. The Contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity. The Contractor shall be an authorized regional representative of the electronic security systems included in the project scope.
2. Provide four (4) current references from clients with systems of similar scope and complexity which became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system. The references must include a current point of contact, company or agency name, address, telephone number, complete system description, date of completion, and approximate cost of the project.
3. The owner reserves the option to visit the reference sites, with the site owner's permission and representative, to verify the quality of installation and the references' level of satisfaction with the system.
4. Provide copies of system manufacturer certification for all technicians. Only utilize factory-trained technicians to install, program, and service the electronic security systems. The Lead Technician shall have a minimum of five (5) continuous years of technical experience in electronic security systems.
5. The Contractor shall have a local service facility located within 60 miles of the project site. The local facility shall include sufficient spare parts inventory to support the service requirements associated with this contract. The COTR and the PPSD Security Engineer

reserves the option of visiting the company's facility to verify the service inventory and presence of a local service organization.

6. Lead network engineer onsite configuring the security data network equipment must have a minimum of a Cisco CCNP route/switch certification.
7. Refer to Division 27 Specifications for additional requirements for cabling.

B. Electrical Components, Devices, and Accessories

1. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Material & Workmanship

1. Unless otherwise specifically provided under this contract, all equipment, material and articles to be incorporated in the work shall be new and of the most suitable grade for the purposes intended.
2. References to any equipment, material, article or patented process, by trade name, make or catalog number shall be regarded as establishing a standard of performance and quality, and shall not be construed as limiting competition.
3. When so directed, the Contractor shall submit samples for approval at the Contractor's expense. Equipment, materials, and articles installed or used without the required approval shall be at the Contractors risk of rejection.
4. Warranties of all work and installed products shall be according to the Contract General Provisions.

1.11 MAINTENANCE & SERVICE

A. General Requirements

1. Provide services required and equipment necessary to maintain the electronic security system in an operational state as specified for a period of one (1) year after formal written acceptance of the system.
2. Provide necessary material required for performing scheduled adjustments or other non-scheduled work. Minimize impacts on facility operations when performing scheduled adjustments or other non-scheduled work. See also General Project Requirements.

B. Description of Work

1. The adjustment and repair of the security system includes the following items computers equipment, communications transmission equipment and data transmission media (DTM), local processors, security system sensors, access control equipment, facility interface, signal transmission equipment, intercoms, and video equipment.

C. Personnel:

1. Service personnel shall be certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily. Advise the COTR and the PPSD Security Engineer in writing of the name of the designated service representative, and of any change in personnel. Provide the COTR and the PPSD Security

Engineer with copies of system manufacturer certification for the designated service representative.

D. Emergency Service

1. The owner shall initiate service calls whenever the system is not functioning properly. Provide the owner with an emergency service center telephone number. Staff the emergency service center 24 hours a day 365 days a year.
2. The Smithsonian Institution has sole authority for determining catastrophic and non-catastrophic system failures.
3. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk. For catastrophic system failures, provide same day four (4) hour service response with a defect correction time not to exceed eight (8) hours from notification.
4. For non-catastrophic failures, provide eight (8) hour service response with a defect correction time not to exceed 24 hours from notification.

E. Work Request

1. Separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion. Deliver a record of the work performed within five (5) working days after the work was completed.

F. System Modifications

1. Make any recommendations for system modification in writing to the COTR and the PPSD Security Engineer. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the COTR and the PPSD Security Engineer.

1.12 PROJECT ENVIRONMENTAL CONDITIONS

A. Control Station

1. Rated for continuous operation in ambient conditions of 60 to 85 deg F (16 to 30 deg C) and a relative humidity of 20 to 80 percent, non-condensing.

B. Interior, Controlled Environment

1. System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 1 enclosure.

C. Interior, Uncontrolled Environment

1. System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F (-18 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, non-condensing. NEMA 250, Type 4x enclosures.

D. Exterior Environment

1. System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -30 to 122 deg F (-34 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 24 in (610 mm) thick. NEMA 250, Type 4X enclosures.

E. Hazardous Environment

1. System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.

F. Corrosive Environment

1. For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.

G. Security Environment

1. Use vandal resistant enclosures in high-risk areas where equipment may be subject to damage.

1.13 EQUIPMENT AND MATERIALS

A. General Equipment Requirements

1. Equipment and materials shall be standard, current products of the manufacturer, and be suitable for the systems being installed and the intent of the design.
2. Any material, device, or equipment damages including dents and marred finishes before or during installation and before acceptance of the completed system, shall be replaced unless repairs can be made that are acceptable to the COTR and the PPSD Security Engineer. Any such replacement or repairs, including repairs to the finish, shall be made at no cost to the Owner.
3. Parts of the project site are finished spaces, including paint, trim, wall covering, floor treatments, lighting, and building mechanical systems. Therefore, perform the work specified herein, such that, at the completion of his work, all finished space is restored to the original condition existing prior to the commencement of work. During the course of performing the work specified herein, if the Contractor encounters any damaged finish in any area where the Contractor’s work is to be performed, notify the COTR in writing prior to performing work in that area. Proceed with the work in these areas only after receiving written confirmation that the existing conditions have been documented and authorization has been given to proceed.

B. Nameplates

1. Provide nameplates for all non-field devices accessed by - Smithsonian Institution Security Maintenance Personnel. This includes but is not limited to the following:
   a. Data Gathering Panels
   b. Security Enclosures
   c. Network Switches
   d. Fiber Switches
   e. Servers
   f. Workstations
   g. Power Supplies (including electrical circuit)
   h. Electrical Circuits
2. The laminated plastic shall be 0.06 in (1.6 mm) thick, black with white lettering center core. Nameplates shall be a minimum of 0.75 in (19 mm) high, with a minimum of 0.13 in (3.3 mm) high-engraved block lettering. Attach nameplates with screws or located as required by security documentation plans and specifications. All console monitors shall be labeled with the monitor number and intended function.
3. Submit planned naming conventions for approval.

1.14 COMPONENT ENCLOSURES

A. Tamper Provisions and Tamper Switches

1. Enclosures with terminal strips or circuit boards require tamper switches.
2. Arrange tamper switches to initiate an alarm signal that will report to the monitoring station when the door or cover is moved.
3. Tamper switches shall be inaccessible until the switch is activated. Be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating. Be spring-loaded and held in the closed position by the door or cover and be wired so they break the circuit when the door cover is disturbed. Tamper circuits shall be adjustable type screw sets and shall be adjusted by the contractor to eliminate nuisance alarms associated with incorrectly mounted tamper device shall annunciate prior to the enclosure door opening (within 1/4 “ tolerance).
4. The single gang junction boxes for the portrait alarming and pull boxes with less than 102 square mm will not require tamper switches.
5. All enclosures over 12 sq in (305 sq mm) shall be hinged with an enclosure lock.
6. Control Enclosures: Maintenance/Safety switches on control enclosures, which must be opened to make routing maintenance adjustments to the system and to service the power supplies, shall be push/pull-set automatic reset type.
7. Provide one (1) enclosure tamper switch for each 24 in (609 mm) of enclosure lock side opening evenly spaced.
8. All security screws shall be Torx-Post Security Screws.

1.15 WARRANTY

A. The Contractor shall, as a condition precedent to the final payment, execute a written guarantee (warranty) to the COTR certifying all contract requirements have been completed according to the final specifications. Contract drawings and the warranty of all materials and equipment furnished under this contract are to remain in satisfactory operating condition (ordinary wear

and tear, abuse and causes beyond his control for this work accepted) for one (1) year from the date the Contactor received written notification of final acceptance from the COTR and the PPSD Security Engineer. Repair or replace all defects or damages due to faulty materials or workmanship without delay, to the COTR's satisfaction, and at the Contractor's expense.

B. When equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, have been replaced or restored because of its failure during the warranty period, the warranty period for the replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

PART 2 - PRODUCTS

2.1 THERE ARE NO PRODUCTS IN THIS SPECIFICATION

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SECURITY INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 GENERAL

A. Install all system components and appurtenances in accordance with the manufacturer's instructions, ANSI C2, and furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

B. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.

C. Firmly attach equipment to walls and ceiling/floor assemblies (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

D. Current Site Conditions: Visit the site and verify site conditions are in agreement with the design package. Report all changes to the site or conditions that will affect performance of the system to the COTR as part of the Pre-Installation Submittal. Take no corrective action without written permission from the COTR.

3.3 SYSTEM PROGRAMMING

A. General

1. The following Loading Sheet submittals are required:

a. Shop Drawings – Pre-Installation Submittal
b. Final Construction Document Submittal – Closeout Submittal

2. Loading Sheets
   a. See the attached loading sheets. Refer to Section 1 regarding loading sheet submissions.
   b. System Configuration and Data Entry:
      1) The contractor is responsible for providing all system configuration and data entry for the SMS and subsystems (e.g., intercom, Inovonics wireless, digital video recorders, network video recorders). All data entry shall be performed to Smithsonian Institution's standards & guidelines. The Contractor is responsible for participating in all meetings with the OPS and the client to compile the information needed for data entry. These meetings shall be established at the beginning of the project and incorporated in to the project schedule as a milestone task. The contractor shall be responsible for all data collection, data entry, and system configuration. The contractor shall collect, enter, & program and/or configure the following components:
         a) Access control system components
         b) All intrusion detection system components
         c) Video surveillance, control and recording systems
         d) Intercom systems components
         e) All other security subsystems shown in the contract documents
3. Graphics
   a. Based on as-built drawings developed for the construction project, create all map sets and system icons showing locations of all alarms and field devices.
   b. Produce graphical maps of all alarm points installed under this contract including perimeter and exterior alarm points.
   c. Create and install all graphics needed to make the system operational.
   d. Utilize data from the contract documents, Contractor's field surveys, and all other pertinent information in the Contractor's possession to complete the graphics.
   e. Identify and request from the COTR and the PPSD Security Engineer, any additional data needed to provide a complete graphics package.
   f. Graphics shall have sufficient level of detail for the system operator to assess the alarm.
   g. Supply hard copy, color examples at least 8 x 10 in (203.2 x 254 mm) of each type of graphic to be used for the completed Security system. Deliver the graphics examples to the COTR and the PPSD Security Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires them.

B. Alarm / Event Identification Format for Monitoring Station

1. Initial Descriptor
   a. The Initial Descriptor is a brief description of the event taking place and shall be no more than 50 characters in length. Contact OPS-PPSD for any Building ID, Area ID or Device / Condition Type not listed below.
   b. Building ID
      1) This is a two (2) or four (4) character identification of the building where the event is taking place. This shall follow the standard format as shown in the listing below. Confirm buildings and identifications with the owner.

Building	ID	Building	ID

Building	ID	Building	ID
African Art	AA	Hirshhorn	HH
Air and Space	AS	Horticulture Greenhouse	HG
American History	AH	Library (STRI)	LB
American Indian (NY)	IN	Maintenance Shop (STRI)	TP
American Indian Mall	IM	MSC (Suitland)	MS
Anacostia	AN	NAOS (STRI)	NAOS
Ancon (STRI)	AC	National Zoological Park	NZ
Apollo Drive	AD	Natural History	NH
Arts and Industries	AB	NMAAHC	AAHC
Barro Colorado (STRI)	BC	Patent Office Building	PB
Bocas del Toro (STRI)	BT	Pennsy Drive	SISC
Capital Gallery	CG	Postal Museum	PM
Columbia Warehouse	CW	Quad	SQ
Conference Center (STRI)	CC	Renwick	RW
Cooper Hewitt (NY)	CH	Research Branch (NY)	RB
CRC (Suitland)	CR	Sackler	SK
Culebra (STRI)	CU	SAO Arizona	AZ
Dulles	DL	SAO Hilo HI	HI
Engineering Building (STRI)	EB	SAO Mauna Kea HI	MK
Folk Life Festival	FF	SCBI Front Royal VA	FZ
Freer	FR	SERC	SR
Galeta (STRI)	GA	SI Castle	SB
Gamboa (STRI)	GM	Tivoli Facility (STRI)	TV
Garber (Suitland)	GB	Tupper Facility (STRI)	TP
Herndon	HN	Victor Building	VB

c. Monitor Point Location
   1) This is the monitor point physical location. There is no separation between the Building ID and the Monitor Point Location.
   2) Description of iStar:
      a) The Monitoring Point Location includes a two (2) character descriptor for the iStar Cluster, followed by a colon and then a two (2) character descriptor for the iStar panel followed by a colon then a one (1) character space.
      b) Next is the one (1) character descriptor for ACM # (1 or 2) ‘ACM:#’ followed by a one (1) character space.
      c) Next is the device connection location for where the device terminates using ‘I8’ for an I-8 module, ‘R8’ for an R-8 module, ‘RDR’ for a reader module, followed by a colon. Then a one (1) character number representing which module it is (i.e. the fourth I-8 module), followed by a colon. Last is a one (1) character number representing the input number on the module; the inputs on the ACM board require a two (2) character number.
   3) Example of iStar

a) xx01:01 ACM:1:i06 = iStar Cluster 01, iStar #01, ACM #1, main panel, sixth input
b) xx01:02 ACM:2 I8:3:i6 = iStar Cluster 01, iStar #02, ACM#2, I-8 module #3, sixth input
c) xx02:16 ACM:1 R8:2:o4 = iStar Cluster 02, iStar #16, ACM #1, R-8 module #2, fourth output
d) xx01:15 ACM:1 RDR:4:i2 = iStar Cluster 01, iStar #15, ACM#1, reader module #4, second input

d. Area ID (Type)
1) This is a brief description of the location of the alarm / event. There shall be a one (1) character space between the Monitor Point Location and the Area ID. At a minimum level of description, this shall follow the standard format as shown in the listing below. Confirm areas and identifications with the owner.

Description	Area ID
Vault	VAULT
Collection Storage	COLL STORAGE
Archive Areas	ARCHIVE
Collection Archive Areas	COLL ARCHIVE
Collection Processing / Preparation Areas	COLL PREP ROOM
Alcohol Storage Areas	ALCOHOL
Cold Collection Storage Areas	COLD STORAGE
Curatorial Areas	CURATORIAL
Exhibit Gallery (XX To be replaced with Gallery No.)	GALLERY XX
Exhibit Alarms Located in Lobbies or Reception Areas	LOBBY EXHIBIT
Exhibit or Artifact Alarms in “Other” Areas	MISC EXHIBIT
Registrar Areas	REGISTRAR
Perimeter Door, Glass Break, Motion	PERIMETER
Staff Cafeteria	STAFF CAFE
Public Access Cafeteria	PUBLIC CAFE
Public Staff Separation Door	STAFF DOOR
Museum Shop	MUSEUM SHOP
Museum Shop Storage Areas	MUSEUM SHOP ST
Cash Processing Areas	CASH ROOM
Automated Teller Machines	ATM
Executive Office Space	EXECUTIVE
Support Staff Office Space	STAFF OFFICE
Loading Dock Areas	LOADING DOCK
Security Unit Control Room	UNIT CONTROL
Security Wire Closet	WIRE CLOSET
Computer Center Rooms	COMPUTER ROOM
Mechanical Room	MECHANICAL

Description	Area ID
Electrical Room	ELECTRICAL
Communication Closet	COMM CLOSET
Fabrication Shop	FABRICATION
Support Staff Storage Area	STAFF STORAGE
Warehouse Storage Area	WAREHOUSE
Shipping and Receiving Area	SHIPPING
Security Officer Kiosks / Posts	SECURITY POST
Information Booths	INFO BOOTH
Locker Rooms	LOCKER ROOM
Laboratories	LABORATORIES
Libraries	LIBRARY
Liquor Storage Areas	LIQUOR STORAGE
Child Care Centers	CHILD CARE
Photo Processing Laboratories	PHOTO LAB
Animal Area for Public Viewing	ANIMAL EXHIBIT
Animal Area not for Public Viewing	ANIMAL OFF-
Outside Animal Area	ANIMAL YARD
Marine Animal Area	ANIMAL TANK
Animal/Keeper Area	KEEPER
Keeper (only) Area	KEEPER SPACE

e. Device / Condition Type

1) This is a two (2) digit descriptor for the type of device / condition that initiated the alarm / event. There is a one (1) character space between the Area ID and the Device / Condition Type. This follows the standard format as shown in the listing below. Confirm device / condition identifications with the owner.

Type of Device / Condition	ID
Door Contact	DC
Motion Detector	MD
Vibration Detector	VD
Glass Break Detector	GB
Hold Up / Duress Button	HU
Bill Trap (Last Bill Detector)	BT
Door Held Open	HO
Door Forced Open	FO
Power Failure	PF
Tamper Alarm	TP
Delayed Egress Pre Alarm	DE
Temperature Alarm	TA
Shock Sensor	SS

Type of Device / Condition	ID
Window Contact	WC
Hazard Alarm	HZ
Case / Display Alarm	CA
Low / Missing Battery	LB
Communication Failure	CF
Security Fault	SF
UPS / Power Supply Trouble	PT
Restore / Reset	RS
Proximity Alarm	PA
Pressure Mat	PM
HVAC Duct Alarm	DA
Lock Secure	LS
Battery Fail	BF

Type of Device / Condition	ID
Photo Beam	PB
Request to Exit	REX
Seismic Alarm	SA
Video Loss	VL
Supervision Error	SE

Type of Device / Condition	ID
Tamper Alarm	TP
Lock	LK
Door Status Monitor	DSM
Sounder	SD

f. Examples for the Initial Descriptor:
   1) National Museum of Natural History monitor point location DGP chain 1 DGP number 2 first I-8 input 4, collection storage motion detector in alarm.
      a) NH01:02 I8:1:i4 COLL STORAGE MD
   2) Arts and Industries Building monitor point location DGP chain 3 DGP number 4 main panel input 6, public staff separation door contact.
      a) AB03:04 M:i6 STAFF DOOR DC

2. Secondary Descriptor
   a. The Secondary Descriptor is 128 characters
   b. This is an in-depth description for the location of the alarm / event taking place. If multiple devices are connected to the same monitor point the number of devices should be indicated.
   c. Examples for the secondary descriptor
      1) National Museum of Natural History monitor point location DGP chain 1, DGP number 6, I32 board input 31, collection storage motion detector in alarm.
         a) NH01:06 I32:i31 COLL STORAGE MD: NMNH 5th Fl East Wing Rm. 5210 Motion Detectors (3).
      2) Arts and Industries Building monitor point location DGP chain 1, DGP number 2 third I-8 board input 5, public staff separation door forced open.
         a) AB01:02 I8:3:i5 STAFF DOOR FO: AIB 1st Fl East Hall Card Access Door Forced Open.
   d. Linked Instruction Event
      1) This is a full instructional description for the processing of the alarm / event and follows the standard format of:
         a) Repeat 50 character descriptor
         b) In-depth description of location
         c) Response instructions
         d) Logging instructions
         e) Reset instructions
         f) Nearest camera location (If multiple views are available list all)
         g) DGP input is connected to
   e. Examples for the linked instructional event
      1) National Museum of Natural History monitor point location DGP chain 1 DGP number 3, I32 board input 31, collection storage motion detector in alarm.

Step	Display
1	NH01:03 I32:i31 COLL STORAGE MD
2	5th fl east wing Rm. 5210 motion detectors (3)
3	Dispatch officer to investigate and report findings

Step	Display
4	Log officer's name and actions into computer log
5	Device resets automatically when motion has stopped
6	Nearest camera is No. (camera Nos. provides other views)
7	Device connected to DGP

A. Alarm / Event Mapping Requirements

1. General
   a. All maps associated with alarm / event call-ups shall be a black foreground on a white background.
2. Map Information Screen
   a. The map information screen shall provide access to three different map levels for each event
   b. Building Floor Map
      1) This map has the quadrant where the event is taking place line colored blue or the colored event icon in place. Identify this map with the building name and floor at the bottom of the map.
   c. Quadrant Map
      1) This is the map called up by the system automatically upon event activation. Identify this map with the building name, floor number, and quadrant at the bottom of the map. This map has the icon representing the event shown upon call up. Clicking on the icon or a map "zoom in" icon at this map level calls up the Area map.
   d. Area Map
      1) This map represents the local area of the building where the event is taking place. This map contains all icons associated with this area. These icons are "living", changing colors as the associated devices change state. Identify this map with the building name, floor number, quadrant, and area name at the bottom of the map.
3. Mapping icons
   a. Mapping icons are "living" changing color as the associated devices change state.
      1) Red = alarm / activated state
      2) Green = secure / normal state
      3) Yellow = masked, shunted, accessed, etc. state
   b. Group and position mapping icons represented on the Area map as follows:
      1) Motion detectors providing back up to perimeter door(s) / window(s).
         a) Place a single icon in a close geographical position to the protected door(s) or window(s), to represent all devices in the zone or group
      2) Motion detectors providing back up to public staff separation doors and other internal doors.
         a) Place a single icon in a close geographical position to the protected door.
      3) Motion detectors providing volumetric protection of a room.
         a) Place a single icon in the center of the room, to represent all devices in the zone or group
      4) Glass break detectors protecting perimeter windows

a) Place a single icon in a close geographical position to the center of the window or group of windows, to represent all devices in the zone or group

5) Door contacts protecting individual perimeter doors or logical groups of perimeter doors.
   a) Place a single icon in a close geographical position to the center of the door or group of doors, to represent all devices in the zone or group
6) Delayed egress pre alarm contacts protecting individual doors or logical groups of doors.
   a) Place a single icon in a close geographical position to the center of the door or group of doors, to represent all devices in the zone or group.
7) Window contacts protecting individual perimeter windows or logical groups of perimeter windows.
   a) Place a single icon in a close geographical position to the center of the window or group of windows, to represent all devices in the zone or group.
8) Card reader events to include door forced open and door held open alarms.
   a) A single icon shall be the same as the door contact protecting the door.
   b) Icon descriptor shall identify the appropriate event taking place.
9) Tamper alarms protecting panels in security closets.
   a) Place a single icon in the center of the room, to represent all devices in the zone or group.
10) Tamper alarms protecting individual devices or logical groups of devices.
   a) Place a single icon in close geographical position to the device or group of devices, to represent all devices in the zone or group.
11) Exhibit level case/display alarms.
   a) A single icon shall represent all devices protecting the case/display.
   b) Place icon directly over the case/display so the case outline is still visible below (around) the icon
   c) Icon descriptor shall identify the appropriate device in alarm.
12) Vibration detectors protecting any physical barrier or point of entry.
   a) Place a single icon in close geographical position to the physical barrier / point of entry or group of devices, to represent all devices in the zone or group.

B. System Programming

1. General Programming Requirements
   a. Use the following section to identify the anticipated level of effort (LoE) required setup, program, and configuring the ESS.
   b. Provide all setup, configuration, and programming to include data entry for the SMS and subsystems (e.g., video system, intercoms, digital video recorders, intrusion devices, maps and icons, time synchronization, including integration of subsystems to the SMS.
2. Configuration Management of Servers
   a. Provide SI-OPS the security system servers for baseline configuration 90 days before system programing begins.

b. Once the security system server is baselined according to SI-OCIO requirements the server will be returned to the security contractor for system programing.
c. There are other programming requirements the contractor needs assistance on as follows:
    1) OPS has to enter the Levels and Permissions of programing
    2) Synchronize system with C-Cure Central
    3) Employee card reader data will be automatically entered in the system server
    4) OPS will enter Card reader Clearances

3. Level of Effort for Programming
    a. Perform and complete system programming (including all data entry) at an offsite location using the Contractor's own copy of the C*Cure 800/8000 software which must be the same version SI is using.
    b. Deliver the completed forms (loading sheets) to the COTR and PPSD Security Engineer for review and approval at least 90 calendar days prior to the scheduled date the Contractor requires it.
    c. Once system programming has been completed, deliver the programming to the COTR and the PPSD Security engineer on data entry forms (loading sheets) and an approved electronic medium.
    d. System programming may not be uploaded until the COTR and the PPSD security Engineer provide written approval.
    e. The Contractor is responsible for backing up the system prior to uploading new programming data.
    f. Additional programming requirements are provided as follows.
        1) Programming for New SMS Server
            a) Provide all other system related programming.
            b) Upload personnel information (e.g., ID Cards backgrounds, names, access privileges, personnel photos, access schedules, personnel groupings)
            c) Coordinate with OPS for device configurations, standards, and groupings. SI shall provide database to support Contractor's data entry tasks.
            d) Conduct a weekly coordination meeting and work alongside OPS to ensure data uploading is performed without incident of loss of function or data loss.
        2) Programming for Existing SMS Servers
            a) Perform all related system programming except for personnel data as noted.
            b) The contractor is not responsible for uploading personnel information (e.g., ID Cards backgrounds, names, access privileges, access schedules, personnel groupings).
            c) Conduct a weekly coordination meeting and work alongside OPS to ensure data uploading is performed without incident of loss of function or data loss.
            d) Perform system programming for SMS servers using the Contractor's own server and software. These servers shall not be connected to existing devices or systems at any time.
    g. Identify any additional data needed to provide a complete and operational system as described in the contract documents and request the information from the COTR and the PPSD Security Engineer.

h. Programming effort requires a high level of coordination between Contractor and OPS to ensure programming is performed in accordance with SI requirements and programming uploads do not disrupt existing systems functionality.
   1) Conduct a weekly coordination meeting and work alongside OPS to ensure data uploading is performed without incident of loss of function or data loss.

i. Ensure data uploading is performed without incident or loss of function or data loss.

j. The following Level of Effort Chart is provided to communicate the expected level of effort required by contractors on SI ESS projects. Determine actual levels of effort prior to bidding on the project.

SMS Setup & Configuration

Description of Tasks	Develop System Loading Sheets	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization
	Coordination	e.g., retrieve IP addresses, naming conventions, standard event descriptions, programming templates, coordinate special system needs
	Initial Set-up Configuration	e.g., Load system Operating System and Application software, general system configurations
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	e.g., program monitoring stations, programming networks, interconnections between CCTV, intercoms, time synchronization
	Final Checks	e.g., check all system diagnostics (e.g., clients, panels)
	Level of Effort (Typical Tasks)	Load and set-up 4-6 CDs and configure servers (to configure Loading and Configuring software Administrative account, audit log Keystrokes, mouse clicks, multi-screen configuration

Electronic Entry Control Systems

Description of Tasks	Develop System Loading Sheets	e.g., setup of device, door groups & schedules, REX, Locks, link graphics
	Coordination	e.g., confirming device configurations, naming conventions, event description and narratives
	Initial Set-up Configuration	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	e.g., setup of device, door groups & schedules, REX, Locks, link graphics
	Final Checks	e.g., performing entry testing to confirm correct set-up and configuration
	Level of Effort (Typical Tasks)	e.g., creating a door, door configuration, adding request to exit, door monitors and relays, door timers, door related events (e.g., access, access denied, forced open, held open), linkages, controlled areas, advanced door monitoring, time zones, sequence of operations

Intrusion Detection Systems

Description of Tasks	Develop System Loading Sheets	e.g., enter door groups & schedules, link devices - REX, lock, & graphics
	Coordination	e.g., confirming device configurations, naming conventions, event description and narratives
	Initial Set-up Configuration	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	e.g., enter door groups & schedules, link devices - REX, lock, & graphics
	Final Checks	e.g., walk test, device position, and masking
	Level of Effort (Typical Tasks)	e.g., setting up monitoring and control points (e.g., motion sensors, glass breaks, vibration sensor, strobes, sounders) creating intrusion zones, creating arm/disarm panel, timed sequences, time zones, icon placements on graphic maps, clearance levels, events (e.g., armed, disarmed, zone violation, device alarm activations), LCD reader messages,

CCTV Systems

Description of Tasks	Develop System Loading Sheets	e.g., programming call-ups recording
	Coordination	e.g., confirming device configurations, naming conventions
	Initial Set-up Configuration	e.g., enter data from loading sheets; camera naming convention, sequences, configure components)
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	e.g., programming call-ups recording
	Final Checks	e.g., confirm area of coverage, call-up per event generated and recording rates
	Level of Effort (Typical Tasks)	e.g., setting up cameras points, recording ratios (e.g., normal, alarm event) timed recording, linkages, maps placements, call-ups

Intercoms Systems

Description of Tasks	Develop System Loading Sheets	e.g., programming events & call-ups
	Coordination	e.g., confirming device configurations, naming conventions, event description and narratives
	Initial Set-up Configuration	e.g., enter data from loading sheets; configure components, link events, cameras, and graphics
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	e.g., programming events & call-ups
	Final Checks	e.g., confirm operation, SMS event generation and camera call-up
	Level of Effort (Typical Tasks)	e.g., setup linkages, events for activations, device troubles, land devices on graphic maps

Console Monitoring Components

Description of Tasks	Develop System Loading Sheets	N/A
	Coordination	per monitor
	Initial Set-up Configuration	per monitor
	Graphic Maps	e.g., develop naming conventions, develop file folders, confirming accuracy of AutoCAD Floor Plans, convert file into jpeg file then to bitmap.bmp file
	System Programming	N/A
	Final Checks	per monitor
	Level of Effort (Typical Tasks)	N/A

Note: Programming tasks are supported through the contractor's development of the Submittals.

END OF SECTION 280500.10

SECTION 280507.10 – POWER SOURCES FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. The power sources support the electronic security systems (ESS).

B. Electrical Power

1. Provide an automatic transfer switch for switching between primary and generator power.

C. Uninterruptible Power Supply (UPS)

1. The switch from primary power to generator shall generate an AC Fail alarm on the Physical Access Control System (PACS).
2. Provide an interface (dry contact closure) between the PACS and the UPS system so the UPS trouble signals and main power fail appear on the PACS operator terminal as alarms.
3. UPS for security equipment shall have the capacity to provide one (1) hour of service.
4. All UPS for security equipment must have 20% extra capacity for future expansion.
5. Dedicated UPS units shall not be floor mounted unless in the UCR. All other UPS units shall be rack mounted.

D. Power Supplies

1. The switch from primary power to generator shall generate an AC Fail alarm on the PACS.
2. Detect and report on the PACS failure of any battery as a fault condition.
3. Size battery backed-up power supplies for eight (8) hours of operation at actual connected load.
4. All power supplies for security equipment must have 20% extra capacity for future expansion.

1.3 SUMMARY

A. This Section includes the following:
1. PACS Power Supplies

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 ISTAR ENCLOSURE / POWER SUPPLY

A. Acceptable Manufacturers

1. Life Safety Power

B. Life Safety PSX-WPISU16E8SN, ProWire 16 Door Access Dual Voltage Enclosure / Managed Power Supply

C. Minimum Required Features and Specifications

1. Input Power
   a. Input 120 VAC 50 Hz 452 Watts
   b. Overload and short circuit protection
   c. Over temperature protection
   d. Polarized AC power supply disconnect
2. Output Power
   a. PSX150: 12V/12A 150 Watts
   b. PSX250: 24V/10A 250 Watts
   c. 16 managed control outputs, fused at 3A each
   d. 16 auxiliary outputs, Class II power limited at 2.5A per output
   e. 120 mV output voltage ripple
   f. System Efficiency: 87%
   g. System BTU Rating: 175 BTU/Hr
3. Battery Charging
   a. Independent built-in 2A charger for sealed lead acid or gel type batteries
   b. Microprocessor dual rate charging of 12 or 24 V battery sets
   c. Charges up to 80Ah battery sets within UL limit
   d. Automatic switchover to standby battery when AC fails
   e. Zero voltage drop when switched over to battery backup
4. Supervision
   a. AC Fail (form "C" contacts)
   b. System Fault (form "C" contacts) may be triggered by low/no battery, short to earth ground, power supply failure or blown fuse
5. Visual Indicators
   a. AC input, DC1 and DC2 output
   b. System fault
   c. AC fault
   d. Short to earth ground
   e. Reverse battery polarity
   f. Fire Alarm Input activated
   g. D8P: DC outputs
   h. M8: DC inputs, outputs and fault
6. Regulatory Compliance (LSP equipment)
   a. UL294, UL1076
   b. ULC S319, CSA C22.2 #107.1
   c. FCC Part 15, CSFM Approved
7. Physical Dimensions Enclosure: (H x W x D) 36 x 30 x 4.5 in (91 x 76 x 11.5 cm)

8. Connect tamper and power outputs to the GCM.
9. Annunciate the following conditions on the security management system: cabinet tamper, AC power fail, and low battery.
10. Provide appropriate number of modules for the specific project.

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 280507.10

SECTION 280513.10 – SERVERS, WORKSTATIONS, AND STORAGE FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. This specification is for the servers, workstations, and storage directly supporting the electronic security systems (ESS) including all software licenses.

1.3 SUMMARY

A. This Section includes the following:

1. Operator Workstations
2. Access Control Servers
3. NVR’s

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 PACS & VASS OPERATOR WORKSTATIONS

A. Acceptable Manufacturers

1. HP
2. Dell

B. HP Z8 G4 or approved equivalent

C. Minimum Required Features and specifications

1. (2) Intel Xeon Silver 4214 (2.2 Ghz base frequency, up to 3.2 Ghz with Intel Turbo Boot Technology, 16.5 MB cache, 12 cores)
2. 1TB SSD storage
3. 64 GB DDR4-2933 SDRAM memory (2 x 32 GB or 4 x 16 GB)
4. HP 9.5 mm Slim DVD-Writer
5. (2) NVIDIA® Quadro® P4000 (8GB GDDR5 memory)
6. Integrated 10/100/1,000 Mbps copper NIC
7. Realtek HD ALC221 audio
8. 1125 W internal power supply, up to 90% efficient, active PFC
9. Windows 10 Pro for Workstation 64-bit

2.2 VIDEO WALL SECURITY WORKSTATION

A. Acceptable Manufacturers

1. HP
2. Dell

B. HP Z8 G4 or approved equivalent

C. Minimum Required Features and specifications

1. (2) Intel Xeon Silver 4214 (2.2 Ghz base frequency, up to 3.2 Ghz with Intel Turbo Boot Technology, 16.5 MB cache, 12 cores)
2. 1TB SSD storage
3. 64 GB DDR4-2933 SDRAM memory (2 x 32 GB or 4 x 16 GB)
4. HP 9.5 mm Slim DVD-Writer
5. (2) NVIDIA® Quadro® P4000 (8GB GDDR5 memory)
6. Integrated 10/100/1,000 Mbps copper NIC
7. Realtek HD ALC221 audio
8. 1125 W internal power supply, up to 90% efficient, active PFC
9. Windows 10 Pro for Workstation 64-bit
10. 2FZ76AA Rack Rail Upgrade Kit for Z8 G4 Workstation

2.3 NETWORK VIDEO RECORDER

A. Acceptable Manufacturers

1. American Dynamics

B. American Dynamics ADVER64R5DJ or approved equivalent

C. Minimum Required Features and Specifications

1. OS Drive: Redundant 1 TB (RAID 1)
2. Network Interface: 2 X 10GigE NICs; 2 x 1 GigE NICs
3. 64 TB Video Storage
4. iSCI External Storage
5. Redundant 495 W Power Supply
6. 600 Mbps Video Recording Throughput
7. 64 TB RAID5 storage

2.4 SNMP MONITORING SERVER

A. Acceptable Manufacturers

1. SolarWinds
2. What's Up gold
3. HP Openview

B. SolarWinds, What's Up gold, HP Openview, or approved equivalent

1. Provide a SNMP monitoring server that will monitor the health of the security system network switches, rack mounted servers, rack mounted metered power strips, wall mounted power supplies, and division 26 provided UPS. Provide a rack mounted service that meets the SNMP solution's recommended server specifications.

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 OPERATOR WORKSTATION

A. Provide the workstation hardware to OPS to image with operating system and baseline configuration and scan for vulnerabilities.

B. OPS will provide the workstation back to the Contractor for installation and configuration of project specific software and licenses.

3.3 ACCESS CONTROL SERVER

A. Provide the Access Control Server hardware to OPS to image with operating system and baseline configuration and scan for vulnerabilities.

B. OPS will provide the server back to the Contractor for installation and configuration of project specific software and licenses.

3.4 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 280513.10

SECTION 280531.10 – COMMUNICATIONS EQUIPMENT FOR ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. This specification is for the communications equipment directly supporting the electronic security systems (ESS).

1.3 SUMMARY

A. This Section includes the following:
   1. Fiber Core Switches
   2. Network Access Switches

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 FIBER CORE SWITCHES

A. Acceptable Manufacturers

1. Cisco

B. Cisco 9500 series C9500-40X-E with C9500-NM-8X or approved equivalent

C. Minimum Required Features and Specifications

1. Forty-eight (48) SFP+ ports
2. Furnish with (2) 950W AC power supplies
3. Switching capacity of 960 Gbps
4. Eight (16) GB of DRAM
5. Eight (16) GB Flash
6. MTBF of 180,640 hours
7. 5-years of Network Advantage license
8. 24/7/365 hardware and software support from OEM with 4-hour onsite parts.

D. Additional Required Options / Parts

1. C9500-NM-8X
2. Four (4) Cisco SFP-10G-SR (For connection between core switches)
3. Other SFPS provided in spec with switch count
4. MultiMode OM4 patch cords

2.2 NETWORK ACCESS SWITCH – 48 PORT

A. Acceptable Manufacturers

1. Cisco

B. Cisco 9300 series C9300-48P with C9300-NM-8X or approved equivalent

C. Minimum Required Features and Specifications

1. Forty-eight (48) 10/100/1000 PoE ports
2. Two (2) 10 Gigabit Ethernet SFP+ ports
3. Four (4) SFP+ modules rated for 400M over MM OM4 cable
4. Redundant power supplies
5. Switching capacity of 256 Gbps
6. 480 Gbps stacking bandwidth
7. Eight (8) GB of DRAM
8. Eight (16) GB Flash
9. MTBF of 277,770 hours
10. Stacking cable
11. Power stacking cable

12. 24/7/365 hardware and software support from OEM with 4-hour onsite parts.

D. Required Options / Parts

1. C9300-NM-8X
2. Four (4) Cisco SFP-10G-SR per access switch (two for the access switch and one for each core switch)
3. MultiMode OM4 patch cords

2.3 NETWORK ACCESS SWITCH – 24 PORT

A. Acceptable Manufacturers

1. Cisco

B. Cisco 9300 series C9300-24P with C9300-NM-8X or approved equivalent

C. Minimum Required Features and Specifications

1. Twenty-four (24) 10/100/1000 copper PoE ports
2. Two (2) 10 Gigabit Ethernet SFP+ ports
3. Four (4) SFP+ modules rated for 400M over MM OM4 cable
4. Redundant power supplies
5. Switching capacity of 256 Gbps
6. 480 Gbps stacking bandwidth
7. Eight (8) GB of DRAM
8. Eight (16) GB Flash
9. MTBF of 299,000 hours
10. Stacking cable
11. Power stacking cable
12. 24/7/365 hardware and software support from OEM with 4-hour onsite parts.

D. Required Options / Parts

1. C9300-NM-8X
2. Four (4) Cisco SFP-10G-SR per access switch (two for the access switch and one for each core switch)
3. MultiMode OM4 patch cords

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 IP ADDRESSING

A. Refer to 280500.10 Submittals for requirements.

3.3 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 280531.10

SECTION 280800.10 – COMMISSIONING OF ELECTRONIC SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. This specification is for the commissioning of electronic security systems (ESS).

1.3 SUMMARY

A. This Section includes the following:
   1. Commissioning of the Electronic Security Systems

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 THERE ARE NO PRODUCTS IN THIS SPECIFICATION

PART 3 - EXECUTION

3.1 PERFORMANCE REQUIREMENTS

A. General

1. Refer to Project Process Diagram (PPD) in 280500.10. Utilize the PPD to develop effective and timely project schedules and submissions to ensure project is substantially complete prior to occupancy.

3.2 CONTRACTOR'S FIELD TESTING

A. Perform the Contractor Field Test (CFT) of all devices utilizing OPS provided forms.

B. Submit test results, including journal logs from CCURE, to COTR and OPS-PPSD.

3.3 PERFORMANCE VERIFICATION TEST (PVT)

A. Based on the OPS-PPSD approval of the Contractor's Field Test, the COTR will schedule the PVT with the Contractor and OPS-PPSD.

B. OPS-PPSD will witness the Contractor conduct the PVT of all devices utilizing the same form as for the CFT.

C. OPS-PPSD reserves the right to stop and abort testing as soon as 10 technical deficiencies are found requiring correction.

1. If the acceptance test is aborted, the re-test will commence from the beginning with a retest of components previously tested and accepted.
2. The Contractor is responsible for all time, travel, and lodging expenses incurred for personnel required to be present for resumption of the PVT.

D. The PVT also includes a physical inspection of the installation quality and workmanship.

E. Submit test results, including journal logs from CCURE, to COTR and OPS-PPSD.

3.4 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 280800.10

SECTION 281000 – ACCESS CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. The physical access control system (PACS) is an enterprise class system with intrusion detection inherent to the PACS controllers. The PACS is the central system for the entire electronic security system. Integrate all other systems (intrusion detection, intercommunications, and video) with the PACS so the PACS provides a single unified control and management platform.

B. This is an extension of the Owner's existing Software House C•CURE 9000 system.

1.3 SUMMARY

A. This Section includes the following:

1. PACS Software
2. PACS Panels
3. Reader Module
4. Card readers

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 PACS SOFTWARE

A. Software Licensing

1. The existing Software House PACS license will support this project.

B. Software Integrations

1. Video Assessment and Surveillance System (VASS) functionality
   a. Control of cameras through the PACS and graphic maps
   b. Associate cameras with access control and alarm events
2. Intercom functionality
   a. Control of intercoms through the PACS and graphic maps
   b. Associate cameras with intercom calls

2.2 ISTAR ULTRA

A. Acceptable Manufacturers

1. Software House

B. Software House iSTAR Ultra

C. Minimum Features and specifications

1. Furnish with both ACMs
2. FIPS 140-2 Complaint
3. Install GCM and ACMs in Life Safety Power enclosure
4. Provide Life Safety Power power supply as specified in 280507.10 – Power Sources for Electronic Security

2.3 INPUT/OUTPUT MODULES

A. Acceptable Manufacturers

1. Software House

B. Provide Software House I8 input module(s) and R8 output module(s) as needed for system expansion or integration

C. Minimum Features and specifications

1. Provides expansion of input and output capacity
2. Compatible with full range of Software House Istar and apC access control panels
3. I8 provides (8) eight Class A supervised inputs
4. R8 provides (8) eight Form C relay outputs
5. Dedicated tamper input included on each module

6. Optional UL-listed enclosure available

2.4 ISTAR EDGE G2

A. Acceptable Manufacturers

1. Software House

B. Software House GSTAR004-POE

C. Minimum Required Features and specifications

1. Localized access control with storage for over 1,000,000 personnel records
2. AES 256 symmetric encryption
3. Jumper-selectable 12 or 24VDC for lock power
4. Power over Ethernet (PoE) Plus Module
5. (4) supervised inputs per reader
6. (2) Outputs per reader
7. UL294 and UL1076

2.5 READER MODULE

A. Acceptable Manufacturers

1. Software House

B. Software House RM-4E or approved equivalent

C. Minimum Features and specifications

1. RM-DCM-2 UL Listed tamper protected enclosure
2. RM-4E module

2.6 CARD READER, STANDARD

A. Acceptable Manufacturers

1. Identiv
2. Software House
3. Approved Equivalent

B. The following readers are tested and acceptable

1. Identiv 8110ABPOOOO-TS449 Standard (Pigtail)
2. Identiv 8110ABTOOOO-TS449 Standard (Terminal Plug)
3. SWH-4130 Standard Reader (Terminal Plug)

C. Minimum Features and specifications

1. Works with C•CURE 800/8000 and C•CURE 9000
2. Read within 3 inches
3. Standard firmware that allows field programming no matter the model
4. Single-gang mounting
5. Black
6. Environmental
    a. IP65 Pigtail models
    b. IP55 Terminal models
    c. Temperature range: -31 to 149 deg F (-35 to 66 deg C)
7. Terminal strip is preferred
8. Low Frequency Card Compatibility (125 kHz)
    a. Indala
9. High Frequency Card Compatibility (13.56 MHz)
    a. PIV
    b. PIV-I
    c. Mi-Fare Classic
    d. DESFire EV1
    e. PLAID
    f. ISO 15693
    g. ISO 14443A/B

2.7 CARD READER, KEYPAD

A. Acceptable Manufacturers

1. Software House
2. Identiv
3. Approved Equivalent

B. The following readers are tested and acceptable

1. Identiv 8210 OABTOOOO-TS449 Standard with keypad (Terminal Plug)
2. SWH-4230 Standard Reader with Keypad (Terminal Plug)

C. Minimum Features and specifications

1. Works with C•CURE 800/8000 and C•CURE 9000
2. Read within 3 inches
3. Standard firmware that allows field programming no matter the model
4. Single-gang mounting
5. Black
6. Environmental
    a. IP65 Pigtail models
    b. IP55 Terminal models
    c. Temperature range: -31 to 149 deg F (-35 to 66 deg C)
7. Terminal strip is preferred
8. Low Frequency Card Compatibility (125 kHz)
    a. Indala
9. High Frequency Card Compatibility (13.56 MHz)
    a. PIV

b. PIV-I
c. Mi-Fare Classic
d. DESFire EV1
e. PLAID
f. ISO 15693
g. ISO 14443A/B

2.8 CARD READER, ARM/DISARM

A. Acceptable Manufacturers

1. Software House
2. Approved Equivalent

B. The following readers are tested and acceptable

1. SWH-TST-100 Touchscreen Reader with LCD display and keypad

C. Minimum Features and specifications

1. Works with C•CURE 9000
2. Encrypted RS-485 communications
3. 4.3” diagonal color TFT capacitive touch screen
4. Built-in motion sensor saves screen life
5. Read within 2.5 inches
6. Future-proof design allows users to add features
7. Black
8. Environmental
   a. Temperature range: -4 to 140 deg F (-20 to 60 deg C)
9. Low Frequency Card Compatibility (125 kHz)
   a. HID proximity
   b. Indala, 26-bit proximity
10. High Frequency Card Compatibility (13.56 MHz)
    a. iCLASS PACS data
    b. iCLASS SE PACS data
    c. iCLASS Seos PACS data
    d. MIFARE CSN
    e. DESFire EV1
    f. EV2 CSN

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 GENERAL

A. Install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Install control signals, communications, and data transmission lines grounding as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

B. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for schematic system installation/termination/wiring data.

C. Attach equipment to walls and ceiling/floor assemblies and held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

3.3 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with EIA/TIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."

3.4 CURRENT SITE CONDITIONS

A. Visit the site and verify site conditions are in agreement with the design package. Report changes to the site or conditions which will affect performance of the system to the COTR and PPSD-Security System Engineer in a report. The Contractor shall not take any corrective action without written permission from the COTR.

3.5 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after correcting unsatisfactory conditions.

3.6 ELEVATOR TRANSITION BOX

A. Provide a 12 x 12 in (305 x 305 mm) NEMA 4 enclosure in the Elevator Equipment Room. This is a transition point between Division 14 cabling and Division 28 cabling.

3.7 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 281000

SECTION 281515 – ELECTRIFIED LOCKING DEVICES 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.

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. This specification is electrified locking devices and accessories in support of the PACS directly supporting the electronic security systems (ESS). All locking and access control must comply with NFPA 101. Coordinate with Division 8 requirements.

1.3 SUMMARY

A. This Section includes the following:

1. Passive Infrared Request to Exit (PIR Rex)
2. Sounders
3. Electrified Locks
4. Electromagnetic Locks
5. Electric Strikes
6. Electric Hinges
7. Electronic Pass-through Hinges

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 PIR REQUEST TO EXIT

A. Acceptable Manufacturers

1. Bosch Security Systems

B. Bosch DS-160 or DS-161 or approved equivalent.

C. Minimum Features and Specifications

D. Request To Exit Detectors:

1. Passive infrared sensor designed for wall or ceiling mounting 7.5 to 15 ft (2.1 to 4.6 m)
2. Provide two (2) form “C” (SPDT) relays rated one (1) Amp. @ 30 VDC for DC resistive loads
3. The detectors relays shall be user adjustable with a latch time from 0.5-64 seconds. The detector shall also include a selectable relay reset mode to follow the timer or absence of motion.
4. Adjustable detection pattern plus or minus fourteen (± 14) degrees
5. Operate on 12 VDC with approximately 39 mA continuous current draw
6. Measure approximately 1.8 x 6.75 x 1.75 in (45 x 171 x 44 mm)

2.2 LOCAL SOUNDER

A. Acceptable Manufacturers

1. Mallory

B. Mallory SC 616N and SC 616CP or approved equivalent.

C. Minimum Features and Specifications

1. Local alarms shall be provided for all perimeter doors and card access controlled doors. All card access controlled doors receive local sounders. The local perimeter door alarms shall be a steady tone (SC 616N) while the card access controlled doors shall have a chime tone (SC 616CP).
2. The local sounder shall be a solid state sounding device with no moving parts. The sounder shall operate on 6-16 VDC at less than 16mA draw and produce a 2900 Hz signal at approximately 80-95 dB dependent upon input power. Sounders shall be powered by the auxiliary power supply. The power circuits supplying power to local sounders shall have an individual fuse for each positive leg between the main power supply output and individual distribution circuit. The fuse shall be rated at 50% of the rating of the fuse protecting the power supply output. The sounder shall be plate mounted to a recessed mounted junction box above and immediately adjacent the protected opening. Where the door is controlled by a card reader, the local sounder may be located on the reader module junction box providing the box is located immediately adjacent the protected opening and not obscured by ceiling tiles. The sounder shall be

located on the secure side of the protected opening. The sounding device shall be activated and reset via the security management system. Each sounder shall be controlled by an individual relay at the DGP or at field relay modules. Reset or silencing of the sounder shall be via the control room operator terminals.

2.3 ELECTRIFIED MORTISE LOCKSET WITH INTEGRATED REX

A. Acceptable Manufacturers

1. Schlage
2. Yale

B. Schlage L9000 Series or approved equivalent.

C. Minimum Features and Specifications

1. Lockset is field-adjustable for handing without opening the lock body.
2. Lock is UL listed and labeled for use on up to 3 hour fire rated openings.
3. Locking and unlocking of the lever handle by electronic operation contained completely within the body of the mortise lock.
4. Field configurable Fail Safe /Fail Secure by means of an external DIP switch setting.
5. Universal input voltage – accepts 12 to 24 VDC.
6. Energy Performance: 0.4 amp max current draw.

2.4 ELECTROMAGNETIC LOCK

A. Acceptable Manufacturers

1. SDC

B. SDC 1570 series or approved equivalent.

C. Minimum Features and Specifications

1. 1,200 lbs. (544 kg) holding force
2. 250/125 mA at 12/24 VDC
3. ANSI/BHMA Grade 1 Compliant
4. UL, CSFM, MEA Listed
5. Lifetime warranty

2.5 ELECTRIC STRIKE

A. Acceptable Manufacturers

1. HES

B. HES 1006 series or approved equivalent.

C. Minimum Features and Specifications

1. UL 10C fire-rated, 3 hour single door (fail secure only)
2. UL 10C fire-rated, 1-1/2 hour double door (fail secure only)
3. ANSI A250.13-2003 windstorm listed
4. UL 1034 burglary-resistant listed and suitable for outdoor use
5. ANSI/BHMA A156.31, Grade 1
6. NFPA-252 fire door conformant
7. ASTM-E152 fire door conformant
8. Capable of use on metal and wood frames
9. Dual voltage 12 or 24VDC continuous duty
10. 0.45 Amps @ 12VDC* continuous duty
11. 0.25 Amps @ 24VDC* continuous duty
12. Stainless steel construction
13. Tamper resistant
14. Static strength 3070 lbs. (1,393 kg) (fail secure)
15. Dynamic strength 350 ft-lbs. (475 N m) (fail secure)
16. Endurance 1,000,000 cycles
17. Fail secure (standard)
18. Non-handed
19. Internally mounted solenoid
20. Accommodates up to 1 in (25.4 mm) deadbolt
21. Plug-in connector
22. Full keeper shims for horizontal adjustment
23. Trim enhancer
24. Five year limited warranty

2.6 ELECTRIC STRIKE, PANIC HARDWARE

A. Acceptable Manufacturers

1. HES

B. HES 9400 series or approved equivalent.

C. Minimum Features and Specifications

1. ANSI/BHMA A156.31, Grade 1
2. Capable of use on metal and wood frames
3. Dual voltage 12 or 24VDC continuous duty
4. 0.45 Amps @ 12VDC* continuous duty
5. 0.25 Amps @ 24VDC* continuous duty
6. Completely surface mounted
7. Stainless steel construction
8. Tamper resistant
9. Static strength 1,500 lbs. (680 kg)
10. Dynamic strength 70 ft-lbs. (95 N m)
11. Endurance 500,000 cycles
12. Included 0.125 in (3.175 mm) spacer plate
13. Field selectable fail safe/fail secure
14. Horizontal adjustment
15. Non-handed

16. Internally mounted solenoid
17. Accommodates up to 0. 5 in (12.7 mm) Pullman latch
18. Five year limited warranty

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 GENERAL

A. Coordinate with Division 8 requirements, finishes, and keyways.

B. OPS Lock Shop will rekey project provided cores. Coordinate with the OPS Lock Shop to purchase correct cylinder/cores.

C. Only Software House certified integrators may terminate cabling on PACS equipment.

3.3 REFER TO 280500.10 AND 281000 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 280515

SECTION 281523 – INTERCOM ENTRY 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.

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. The Intercom system is an enterprise class system. Integrate with the Physical Access Control System (PACS) so the PACS provides a single unified control and management platform. Link calls to video system for event driven camera call-up and recording.

B. This is an extension of the Owner's existing Vingtor-Stentofon system.

1.3 SUMMARY

A. This Section includes the following:

1. Video Intercom
2. Video Intercom Master

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 VIDEO INTERCOM

A. Acceptable Manufacturers

1. Vingtor-Stentofon

B. Vingtor-Stentofon TCIV-3+ with adapter plate or approved equivalent.

C. Minimum Features and Specifications

1. Integral HD video camera up to 1080p resolution
2. IP 66 rated
3. Black Thermoplastic front plate with single button
4. Noise cancelling – suppression of musical noise
5. Wide angle lens
6. Scream Alarm
7. PoE IEEE 802.3af standard, IEEE 802.3at
8. UL Certified
9. Operating temperature range -22 to 158 deg F (-30 to 70 deg C)

2.2 VIDEO INTERCOM MASTER

A. Acceptable Manufacturers

1. Vingtor-Stentofon
2. Approved Equivalent

B. Vingtor-Stentofon (1490001010) ITSV-2 with adapter plate or approved equivalent

C. Minimum Features and Specifications

1. Video desktop intercom supporting ICX-Alphacom, SIP, and IC-EDGE solutions
2. 12.7 cm (5 in) capacitive 5-point touchscreen HD TFT LC
3. Built-in Bluetooth
4. Dual-mic HD speakerphone with noise reduction
5. Video Resolution: Up to 720p
6. Video frame rate: Up to 30 fps
7. Power over Ethernet 802.3af Class 3, 802.3at, Class 4

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems".

3.2 INTERCOMMUNICATION SYSTEMS

A. Installation

1. Install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and as shown including all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable duress communications system.

B. Tamper Resistant Substations

1. Locate substations where shown on the drawings. Provide recessed back boxes in which the substation operating mechanisms shall be mounted. Mount substation with the call button centerline no higher than 42 in (1100 mm) above the finished floor.

3.3 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 281523

SECTION 281525 – ELECTRONIC KEY MANAGEMENT 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.

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. The Electronic Key Management System is an extension of the PACS (281000).

1.3 SUMMARY

A. This Section includes the following:

1. Electronic Key Management System

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 KEY MANAGEMENT SYSTEM

A. Acceptable Manufacturers

1. Morse Watchmans

B. Morse Watchmans KeyWatcher® Touch 9 Module Starter Cabinet or approved equivalent

C. Minimum Features and specifications

1. Integrate with CCURE 9000
2. Up to 14,400 keys and 10,000 users per site
3. Fully scalable
4. 7” full color touchscreen
5. Vandal-resistant, illuminated, steel cabinet.
6. 48 hour batter backup
7. Color-coded, Smart keys with identification microchip
8. Tamperproof keyrings
9. Enterprise key return support
10. Enterprise key locator

D. Modules:

1. 6-Key
2. 16-Key

E. Software Integration

1. Software House C•CURE PACS
   a. Add/modify/ delete personnel form KeyWatcher Touch
   b. Link changes in personnel credential data to KeyWatcher users
   c. Associate KeyWatcher site profiles with C•CURE clearances
   d. Transmit KeyWatcher alarms and events via C•CURE alarms
   e. Assign time restriction to groups in profiles based on C•CURE schedules

F. Additional Required Options / Parts

   a. One (1) Keywatcher Touch 9 Module Add on cabinet

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 INSTALLATION

A. Install all system components and appurtenances in accordance with the manufacturers' instructions, ANSI C2, and furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified.

B. Consult the manufacturers' installation manuals for all wiring diagrams, physical equipment sizes, etc., before beginning system installation.

C. Mount unit per manufacture's recommendations. Securely mount and anchor based on wall type and cabinet loading. Fasteners and supports shall be adequate to support the required load.

3.3 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 281525

SECTION 282000 – VIDEO

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. The Video Assessment and Surveillance System (VASS) is an enterprise class system. Integrate with the PACS so the PACS provides a single unified control and management platform. Link video to events and alarms on all other systems (intrusion detection, intercommunications, and PACS) with the PACS.

B. This is an extension of the Owner's existing American Dynamics Victor system.

C. Provide a new NVR as listed in 280513.10 – Servers, Workstations, and Storage for Electronic Security with all associated licenses.

1.3 SUMMARY

A. This Section includes the following:

1. Cameras
2. Video Desktop Controller

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 MULTI-LENS DOME CAMERA, 8MP

A. Acceptable Manufacturers

1. Hanwha Techwin
2. Approved Equivalent

B. Hanwha Techwin PNM-9084QZ or approved equivalent

C. Minimum Required Features and Specifications

1. Outdoor vandal-rated network Multi-Sensor Multi-Directional dome camera
2. Image Sensor: 4 x 2MP
3. Resolution
   a. Total: 7680 H x 1080 V
   b. Per Sensor: 1920 H x 1080 V
4. Wide Dynamic Range: 120dB
5. Frame Rates:
   a. H.265/H.264: Max. 60fps/50fps
6. Remote Focus
7. Day & Night Auto (ICR)
8. Max 33W (HPoE)
9. Outdoor rated IP66 and IK-10 Impact-Resistant Housing
10. Motion Detection, Tampering, Advanced Video Analytics
11. H.265, H.264, MJPEG Codec Supported
12. Minimum Illumination:
    a. Color: 0.04 Lux
    b. B/W (Night Mode): 0.004 Lux
13. Operating Temperature: -40 to 131 deg F (-40 to 55 deg C)
14. Humidity: 0% to 90% (non-condensing)
15. Total dimensions: 9.88 x 4.58” (251 x 116.5 mm)

2.2 MULTI-LENS DOME CAMERA, 20MP

A. Acceptable Manufacturers

1. Hanwha Techwin
2. Approved Equivalent

B. Hanwha Techwin PNM-9085RQZ or approved equivalent

C. Minimum Required Features and Specifications

1. Outdoor vandal-rated network Multi-Sensor Multi-Directional dome camera
2. Image Sensor: 4 x 5MP
3. Resolution: 2560 H x 1920 V
4. Wide Dynamic Range: 120dB

5. Frame Rates:
   a. H.265/H.264: Max. 30fps
6. Remote Adjustment
7. Day & Night Auto (ICR)
8. Max 45W (HPoE)
9. Outdoor rated IP66 and IK-10 Impact-Resistant Housing
10. Analytics: Motion Detection, Tampering
11. H.265, H.264, MJPEG Codec Supported
12. Minimum Illumination:
    a. Color: 0.11 Lux
    b. B/W (IR LED on): 0 Lux
13. Operating Temperature: -40 to 131 deg F (-40 to 55 deg C)
14. Humidity: 0% to 90% (non-condensing)
15. Total dimensions: 12.40 x 5.74” (315 x 145.9 mm)

2.3 FIXED DOME CAMERA, 4MP

A. Acceptable Manufacturers

1. Illustra
2. Approved Equivalent

B. Illustra cameras IPS04-D12-OI04 or approved equivalent

C. Minimum Required Features and specifications

1. Remote setup
2. Image Sensor: 4 MP
3. Resolution: 2560 H x 1920 V
4. Minimum Illumination:
   a. Color (Day Mode): 0.03 Lux
   b. B/W (Night Mode): 0.0002 Lux
   c. B/W (Night Mode): 0.0 Lux, IR sensitive
5. Motorized Varifocal and Focus, P-Iris
6. Power: Power over Ethernet (PoE) IEEE 802.3af/802.3at Type 1 Class 3
7. Allows 90 degree image rotation for better coverage in hallways and corridors
8. True day/night CF removal
9. Max Frame Rate: 60 frames per second
10. Micro SDXC Card Slot up to 1TB
11. Outdoor rated IP66/IP67 and IK-10 Impact-Resistant Housing
12. Operating Temperature: -58 to 149 deg F (-50 to 65 deg C)
13. Total dimensions: 5.4 x 5.3 in (138 x 135 mm)

2.4 VIDEO DESKTOP CONTROLLER

A. Acceptable Manufacturers

1. American Dynamics

B. American Dynamics AD2089 or approved equivalent

C. Minimum Required Features and specifications

1. Compatible with American Dynamics Intellex and Victor
2. Full function CCTV System keyboard.
3. Camera, monitor, DVR and satellite site selection
4. DVR control
5. LED display with brightness control
6. Tactile full travel keys
7. Lens control
8. Dimensions, desktop: 3.0 x 16.5 x 5.25 in (76.2 x 419 x 138 mm)
9. Operating Temperature: 32 to 104 deg F (0 to 40 deg C)

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 GENERAL

A. Install all system components and appurtenances in accordance with the manufacturer's instructions, ANSI C2, and furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Control signals, communications, and data transmission lines grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

B. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Refer to the Riser/Connection diagram for all schematic system installation/termination/wiring data.

C. Attach equipment to walls and ceiling/floor assemblies and be held firmly in place (e.g., sensors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

D. Current Site Conditions: Visit the site and verify site conditions are in agreement with the design package. Report all changes to the site or conditions that will affect performance of the system to the Owner. Do not take any corrective action without written permission from the Owner.

E. Cameras

1. Install cameras with the proper focal length lens as indicated for each zone
2. Set cameras with fixed iris lenses to the proper f-stop to give full video level
3. Aim camera to give field of view as needed to cover the alarm zone / intended field of view
4. Aim fixed mount cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun
5. Focus the lens to give a sharp picture over the entire field of view.
6. Use a fine focus target for final focus adjustments.

F. Camera Pole and Mounts: The Contractor shall install the camera mount as specified by the manufacturer and as shown; provide mounting hardware sized appropriately to secure the mount, camera and housing with maximum wind and ice loading encountered at the site; provide a foundation for each camera pole as specified and shown; provide a ground rod for each camera pole of correct length as dictated by soil conductivity and connect the camera pole to the ground rod; provide electrical and signal transmission cabling to the mount location; connect signal lines and AC power to mount interfaces; connect pole wiring harness to camera.

3.3 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean video surveillance system components, including camera-housing windows, lenses, and monitor screens.

3.4 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 282000

SECTION 283100 – INTRUSION DETECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. The Intrusion Detection System is an inherent part of the PACS system. Link alarms to video system for event driven camera call-up and recording.

1.3 SUMMARY

A. This Section includes the following:

1. Motion sensors
2. Door position switches

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 CARD READER, ARM/DISARM

A. Refer to 281000 – Access Control for specifications

2.2 360 DEGREE DUAL-TECH MOTION SENSOR

A. Acceptable Manufacturers

1. Bosch
2. Approved Equivalent

B. Bosch DS9370 and DS9371 or approved equivalent.

C. Minimum Features and Specifications

1. Up to 25 ft (7.6 m) mounting height
2. 360 degrees x 70 ft (20 m) diameter pattern
3. Fully-adjustable optical arrays for coverage customization
4. Rated for use in difficult environment to reduce false alarms from background disturbances such as air movement and hanging signs.
5. Combination of passive infrared (PIR) detection, microwave detection, and advanced signal processing technology.
6. Built-in tamper switch
7. Operating Temperature: -40 to 120 deg F (-40 to 49 deg C)
8. Dimensions: 3.5 x 7 in (8.9 x 17.8 cm)
9. Voltage: 9 to 15 VDC
10. UL Listed

2.3 DOOR POSITION SWITCH; RECESSED

A. Acceptable Manufacturers

1. Magnasphere
2. Approved Equivalent

B. Magnasphere MSS-19 Series, MSS-25 Series or approved equivalent

C. Minimum Features and Specifications

1. UL 634 Listed
2. Recessed
3. Magnetic tamper
4. 0.75 in (19 mm) or 1 in (25.4 mm) diameter
5. Capable of operating with a 0.5 in (13 mm) gap
6. Screw Terminals or 12 in (305 mm) wire leads, #22 AWG, solid

PART 3 - EXECUTION

3.1 GROUNDING

A. Comply with requirements in Section 270526.10 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

3.2 SYSTEM INTEGRATION

A. Integrate intrusion detection system with the following systems and equipment:

1. Electronic door hardware – locking/unlocking, request-to-exit
2. Elevators – none
3. Network lighting controls – none
4. Intercommunications and program systems – none
5. Public address and mass notification systems – none
6. Access control – door contacts and IDS zones
7. Fire-alarm system – none
8. Perimeter security system – none
9. Video surveillance – video call-up of appropriate camera(s) for each alarm activation

3.3 SYSTEM INSTALLATION

A. Comply with UL 681 and NFPA 731.

3.4 GENERAL

A. Supervision

1. Configure system components to continuously monitor for normal, alarm, line supervision, tamper, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.
2. Trouble Condition Signal: Indicates the system is not fully functional (e.g. sensor battery failure, open or shorted/grounded transmission line conductors, or device cover removed).

3.5 REFER TO 280500.10 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 283100

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE ALARM SYSTEMS

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.

B. The following sections apply to the work of this section:

1. 010000 Supplementary Conditions For Construction
2. 078413 Penetration Firestopping
3. 260501 Common Work Results - Electrical

1.2 SUMMARY

A. Scope: The contract drawings are conceptual. This work includes modifying the existing Siemens XLS addressable fire alarm and voice evacuation system as required to accommodate the renovations SI Quad building. The system shall include all wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm and supervisory signals, initiating devices, alarm notification appliances, interfaced equipment, and all other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described.

B. Existing Equipment: Existing or fire alarm equipment located in areas outside of the project area shall be maintained operational at all times throughout the course of the project.

C. Equipment Removal: Contractor shall remove all existing equipment identified to be removed, and all damaged surfaces shall be restored to finishes similar to surrounding walls/ceiling/floor. Detectors shall remain covered during removal and while in storage. Operational equipment which was removed shall be carefully packaged, labeled, and turned over to the COTR. Other material, such as conduit and electrical boxes, shall be removed from the site and disposed of by the Contractor.

D. Repair/Service Replacement Parts: Repair services and replacement parts for the system shall be furnished under this contract after the date of final acceptance of work by the Smithsonian Institution. On-site service during the warranty period shall be provided within 24 hours after notification. All repairs shall be completed within 48 hours after notification.

1.3 DEFINITIONS

A. COTR: Contracting Officer Technical Representative

B. FM: FM Global (Factory Mutual)

C. FPE: Fire Protection Engineer

D. Furnish: To supply the stated equipment or materials

E. Install: To set in position and connect or adjust for use

F. NFPA: National Fire Protection Association

G. NICET: National Institute for Certification in Engineering Technologies

H. OSHEM: Office of Safety Health and Environmental Management

I. Provide: To furnish and install the stated equipment or materials

J. UL: Underwriters Laboratories

1.4 SYSTEM DESCRIPTION:

A. The System shall be a complete, supervised, noncoded, addressable multiplex fire alarm system with voice/strobe evacuation, dual channel intelligent analog alarm initiation, conventional smoke detection initiation, and complying with all aspects of the applicable documents listed herein.

B. The system shall include all materials, accessories, and equipment to provide a system complete and ready for use.

C. Design and provide each system giving full consideration to obstructions, blind spaces, piping, electrical equipment, duct work and other construction and equipment in accordance with detailed drawings to be submitted for approval.

D. Equipment shall be UL listed or FM approved for use in wet pipe sprinkler systems.

E. In the NFPA publications referred to herein, the advisory provisions shall be considered mandatory, as though the word "shall" had been substituted for "should," wherever it appears.

1.5 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72, all contract documents, and the Smithsonian Fire Protection and Life Safety Design Manual.

B. The system shall be classified as a proprietary protective signaling system.

C. Control features:

1. The main system fire alarm control panel is located in Security Control Room 0101.

2. The existing fire alarm sequence of operations shall be existing to remain.

3. A subprogram shall be provided to allow environmental compensating for smoke detector sensitivity. Each smoke detector shall be programmed with this capability.

4. The system shall provide a field-test function where one person can test the complete system or a specified area at the fire alarm control panel while maintaining full

operational function of other areas not under test. Alarms, troubles, device types, and the initiation device addresses shall be logged to historical memory.

5. Provide a manual pull station attached to the fire alarm control panel that activates the general alarm. Resetting the manual pull station (and all other activated alarms) will cause the general alarm to cease operating. OSHEM must approve the final sequence of operation.

6. Provide program capability via switches or buttons in a locked portion of the fire alarm control panel to bypass the notification appliance circuits, air handler shutdown, smoke control operation, elevator recall, fire door release, horizontal/vertical fire curtain release, and door unlocking features. Operation of these switches or buttons shall initiate this action as a supervisory signal on the FACP display.

7. History Logging - recirculating last 500 events, minimum. History shall be downloadable by classification for selective event reports. If installing pipe over electrical equipment is unavoidable, provide drip pans under piping to protect electrical equipment.

8. Supervision: All existing to remain fire alarm circuits shall maintain their current supervision level.

9. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.

10. Provide electrical supervision of the circuits leading to interfacing modules for the monitoring of contact type initiation devices, the control of electrical devices, fire pump controllers, load control relays (controlling elevators and HVAC equipment), and each independent smoke detection, kitchen, and gaseous fire suppression systems.

D. Spare Capacity

1. All installed signaling line circuits and notification appliance circuits shall have 20 percent spare capacity.

2. All amplifiers shall have 20 percent spare capacity.

3. Battery size shall be a minimum of 125 percent of the calculated requirement.

4. All circuits shall be sized to provide no greater than a 10% voltage drop from normal operating voltage.

E. Fire Alarm Functions: Fire alarm system functions and operations shall be existing to remain.

1.6 SUBMITTALS

A. General: Refer to Section "SUBMITTALS" for basic information relating to submittal requirements. Partial submittals will not be acceptable and will be returned without review. Before any work is commenced, the submittal must be approved by the Office of Safety, Health and Environmental Management (OSHEM). Any work performed by the

contractor prior to their approval will be at the contractor's own risk. If such work is contrary to applicable codes and contract documents, the contractor shall bear all costs including, but not limited to, demolition, reconstruction, and all costs and expenses associated with revising the fire alarm system to meet all applicable codes and contract document requirements. All working drawings shall be a minimum 24 in by 36 in. Electronic submittals in PDF based format are also acceptable.

B. System Description: Submit a detailed description of the control panel as it shall operate for this specific installation. General system descriptions from the catalog cuts and copies of the Systems Design Operation portion of this specification will not be acceptable. All equipment shall be compatible and listed/approved for operation with one another. Any accessory panel shall be compatible with the fire alarm panel(s).

C. Equipment: Include annotated catalog data showing manufacturer's name, model, voltage, and catalog numbers for all equipment and components of the following:

1. Fire alarm control panel (FACP) (Including any required interface modules, covers, console rack, video display unit, amplifier panels etc.)
2. Strobe power extender panels
3. Storage batteries
4. Battery charger
5. Cabinet
6. Addressable interface devices
7. Terminal cabinets/assemblies
8. Addressable relays and interface modules
9. Graphic annunciator panel
10. Amplifiers (primary and back-up)
11. Wire
12. Boxes
13. Terminal strips
14. Relays
15. Transient voltage surge suppressors
16. Conduit
17. Support systems

D. Shop Drawings: Provide three sets of working drawings not smaller than 24 inches by 36 inches (914 mm by 914 mm) and an electronic file. Shop drawings shall be prepared on a Computer Aided Drafting (CAD) System. As a minimum, the shop drawing submittal shall include the following:

1. Interior wiring diagram for FACP.

2. Field wiring color code scheme.

3. Complete riser diagrams indicating the wiring sequence of all devices and their connections to the control equipment. Provide a color code schedule for the wiring.

4. Provide floor plans showing the location of all devices and equipment.

5. Detailed sequence of operations and matrix.

a. Contractor shall perform all functional testing required in order to field verify the complete existing sequence of operations of the fire alarm system, to include all alarm, supervisory and control functions. This field verified sequence of operations shall be shown on the shop drawings and on the as-built documents.

E. As-Built (Record) Drawings: On a daily basis the contractor's superintendent shall record as-built conditions on a set of Shop Drawings maintained at the job site. Two sets of Shop Drawings reflecting as-built conditions shall be available prior to the final acceptance test. Two weeks after the acceptance test and before final acceptance of the work, furnish four complete sets of as-built drawings. The drawings shall be prepared on uniform sized sheets not less than 24 inches by 36 inches (609 mm by 914 mm). The drawings shall include:

1. As-built location of all devices and equipment. Device addresses shall be listed next to each device.

2. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.

3. Riser diagram,

4. All deviations from the project drawings and approved shop drawings.

F. Record Drawing Software: Provide three (3) compact discs containing CAD based drawings in DXF and PDF format of all as-built drawings and schematics. All as-built submittals shall also be digitally transmitted to the COTR.

G. Device Addresses: Prior to fire system installation, provide for approval a complete list of device addresses with corresponding commands, controls, and sequence of operation.

H. LCD Display Messages: The fire alarm control panel shall display messages in the following format: Device type, Floor, Room/Location. All messages for tamper and waterflow switches shall also display the zone and device location.

I. Qualification Data: For Designer and Installer.

J. Descriptions on Graphic Annunciators: Prior to fire system installation, provide descriptive labels for graphic annunciator labeling which will include strobe and voice evacuation zones, sprinkler zones, sprinkler valve locations, HVAC zones, fire walls, stairwells, and elevators.

K. Service Manuals and Equipment Descriptions : Thirty days prior to the final acceptance test and after the preliminary testing has been completed submit the following:

1. Furnish four (4) bound copies of complete service manuals to include: device and board specifications, operation, installation, and maintenance manual; manufacturers installation instructions for all aspects of the installation; Test Mode Operating Instructions; manufacturer's wiring specifications for the system; training manual.

2. Maintenance checklists for equipment.

3. As-built circuit diagrams, complete with color-code scheme, and device descriptions.

4. Complete parts list by make model number and manufacturer.

5. List of smoke detector addresses and corresponding sensitivity readings.

6. Copies of approved submittal materials.

L. Calculations:

1. Battery capacity calculations. The battery calculations shall be detailed to show device quantity, standby current, alarm current and total current to justify proposed battery size. Ampere-hour requirements for each system component and each panel component shall be submitted with the calculations.

2. Supervisory power requirements for all equipment.

3. Alarm power requirements for all equipment.

4. Power supply rating justification showing power requirements for each of the system power supplies.

5. Justification showing power requirements of the system amplifiers. Amplifiers shall be sized for a minimum of 1 watt per connected speaker in common areas and 0.5 watt per speaker in all other locations.

6. Voltage drop calculations for NAC wiring runs demonstrating worst-case condition. Show capability of 70.7 vrms circuits for wire runs. Maximum permissible voltage drop is 10% from normal operating voltage.

7. Provide complete battery calculations for both the alarm and supervisory power

requirements. Ampere-hour requirements for each system component shall be submitted with the calculations.

M. FACP Wire Chart: Prepare a system wire chart. Chart every wire showing the wire number, color, size, type of circuit, designation, origination point and termination point. The chart shall be typewritten with minimum 12-point lettering on paper that is 8.5 inches by 11 inches. The format of the wire chart shall be as shown on the contract drawings. Provide one copy of the wire chart in a sealed plastic envelop inside the fire alarm control panel.

N. Terminal Cabinet Wire Chart: Prepare a wire chart of the wires in each terminal cabinet. Chart every wire showing the wire number, color, size, type of circuit, designation, origination point and termination point. The chart shall be typewritten with minimum 12-point lettering. The format of the wire chart shall be as shown on the contract drawings. The chart must be protected with a clear laminate and mounted in each cabinet so that it does not interfere with the wiring or terminals.

O. Work Schedule: All work must be coordinated with facility operations. Museum operations may require limited access to areas, arranging for museum security personnel to accompany contractors in non-public areas, and working during off-hours. Prior to initial work, meet with museum staff to establish a work schedule. A work schedule must be submitted for approval prior to initial work.

P. Certificate of Compliance: Within two weeks after passing the acceptance test, submit a certificate of code and contract compliance to the COTR in accordance with NFPA 72.

1.7 QUALITY ASSURANCE

A. Manufacturers Qualifications

1. Testing Services or Laboratories: Construct all fire alarm and fire detection equipment in accordance with the latest edition of the following publications from Underwriters Laboratories (UL) and Factory Mutual Engineering Corporation (FM):

a. UL Fire Protection Equipment Directory

b. UL Electrical Construction Materials Directory

c. UL 38 – Manually Actuated Signaling Boxes for Use With Fire Protection Signaling Systems

d. UL 228 – Door Holding Devices

e. UL 268 - Smoke Detectors for Fire Protective Signaling Systems

f. UL 268A - Smoke Detectors for Duct Application

g. UL 464 - Audible Signal Appliances

h. UL 497A – Secondary Protectors for Communications Circuits

i. UL 521 - Heat Detectors for Fire Protective Signaling Systems

j. UL 864 - Control Units for Fire Protective Signaling Systems

k. 1283 – Electromagnetic Interference Filters

l. UL 1449 - Transient Voltage Surge Suppressors

m. UL 1480 - Speakers for Fire Protective Signaling Systems

n. UL 1971 - Signaling Devices for the Hearing Impaired

o. FM Approval Guide

2. Codes and Standards, Latest Edition

a. International Building Code

b. NFPA 70, National Electrical Code

c. NFPA 72, National Fire Alarm and Signaling Code

d. NFPA 101, Life Safety Code

e. Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).

f. ASME/ANSI A 17.1, Safety Code for Elevators and Escalators

B. Qualifications of Installer

1. Design of the fire alarm system and preparation of associated shop drawings and calculations shall be by a NICET Level III or IV Technician or a Registered Fire Protection Engineer.

2. Installer shall have an office, which has been in existence for at least 3 years, within a 75 mile radius of the project site.

3. Installation shall be accomplished by an electrical contractor with a minimum of five years' experience in the installation of fire alarm system of similar size and capacity.

4. The installer shall be at minimum NICET Level II and shall be onsite when any work on the fire alarm system is performed. This includes all fire alarm conduit installation, wire pulls, and terminations.

5. The services of a technician provided by the contractor shall be provided to supervise installation, adjustments, and tests of the system. This technician shall have a NICET Level III on staff to verify that the work is being done correctly.

6. The certifications of the installer and technician must be part of the submittals and must be approved by OSHEM prior to the start of their work. If the installer or technician is changed at any point during the project, the credentials of the replacement must be submitted and approved prior to the start of their work.

C. Distributor/ Service Organization/ Designer Qualifications: Design Personnel certified by NICET as Fire Alarm Level III or IV. The manufacturer's equipment distributor shall show evidence of certification by the manufacturer in the technical support of the system installed under this contract.

1. The distributor shall show evidence of certification of at least one employee by the NICET at Level III or IV in the Fire Alarm Systems subfield of Fire Protection Engineering Technology. If such a certified individual is not employed, adequate documentation shall be provided to show comparable training and experience of an existing employee. At a minimum, comparable training and experience shall consist of ten years of progressive experience in the installation and design of fire alarm systems of similar size and complexity to that specified herein.

2. In lieu of an employee with NICET Level III or IV certification, the distributor shall show evidence of at least one employee with a minimum of ten years of progressive experience in the design of fire alarm systems. In addition, the distributor shall show evidence of technical support in the design, installation, and testing of the systems from a manufacturer-affiliated company, which shall show evidence of certification of at least one employee by the NICET at level III or IV in the Fire Alarm Systems subfield of Fire Protection Engineering Technology.

3. The contractor shall furnish evidence that the fire alarm equipment supplier has an experienced and effective service organization, which carries a stock of repair parts for the system being furnished. Should the Contractor fail to comply with the service requirements of this section, the Smithsonian will then have the option to make the necessary repairs and back-charge contractor without any loss of warranty as provided by the contract documents.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 DELIVERY STORAGE AND HANDLING

A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf

life if applicable.

B. Store materials inside, under cover, above ground, kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by The Smithsonian Institution or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify COTR no fewer than two days in advance of proposed interruption of fire alarm service.

2. Do not proceed with interruption of fire alarm service without The Smithsonian Institution's written permission.

3. No system shall be out of service during non-business hours unless a fire watch is established.

4. System troubles shall be documented at the beginning of a work shift. Any troubles created during the shift shall be brought to the COTR’s attention and rectified before end of shift if requested.

1.10 TEMPORARY FIRE PROTECTION

A. Contractor shall be responsible for any temporary connections that are required in order to keep the fire alarm system active in areas outside of the project area.

1.11 WARRANTY

A. The Contractor shall guarantee labor, materials, and equipment provided under this contract against defects for a period of one year after the date of final acceptance of this work by the Smithsonian and after the receipt of as-built drawings and schematics of all equipment.

B. A full warranty fire alarm test shall be provided by the installed one month prior to warranty expiration.

1.12 EXTRA MATERIALS

A. Spare parts shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, stamping or tagging.

B. Furnish the following spare parts. Quantity shall be two percent of the installed number of devices, but not less than the quantities listed:

1. Smoke Detectors of each type installed: 5

2. Heat detectors: 2

3. Manual pull stations: 2

4. Fuses for each fused circuit: 5

5. Electromagnetic door holder: 1

6. Lamps for each lamp type furnished: 5

7. Keys shall be provided for all fire alarm cabinets: 5

8. Wrenches or special tools required to gain access to all lockable equipment: 5

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements and compatibility to Smithsonian monitoring system, manufacturers offering products that may be incorporated into the Work is limited to the following:

1. FACP, cabinets, and peripheral devices:

a. Siemens.

2. Wire and Cable:

a. As per Part 3 of this Section.

3. Conduit:

a. As per Part 3 of this Section.

4. Boxes, supports, terminal blocks, and appurtenances:

a. As per Part 3 of this Section.

B. All new components shall be provided by one manufacturer.

2.2 FIRE ALARM CONTROL PANEL (FACP):

A. The existing fire alarm control panel is a Siemens XLS addressable fire alarm and voice evacuation system. The existing fire alarm control equipment is to remain.

2.3 AMPLIFIERS, PREAMPLIFIERS AND TONE GENERATORS

A. General: Amplifiers, preamplifiers, tone generators, digitalized voice drives and all other hardware necessary for a complete, operational dual channel voice/alarm signaling service conforming to NFPA 72 shall be housed in a remote fire alarm control unit, terminal cabinet, or in the fire alarm control panel. Each amplifier shall have two channels: one to broadcast a message and the other for paging.

B. Construction: Amplifiers shall utilize solid-state components and shall be provided with output protection devices sufficient to protect the amplifier against any transient voltage up to ten times the highest rated voltage in the system.

C. Inputs: Each system shall be equipped with separate inputs from the tone generator, digitalized voice driver and panel mounted microphone. Microphone inputs shall be of the low impedance, balanced line type. Both microphone and tone generator input shall be operational on any amplifier.

D. Tone Generator: The tone generator shall be of the modular, plug-in type with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces. The tone generator shall produce a slow whoop tone, which shall slowly ascend from low (500 hertz) to high (1200 hertz), and be constantly repeated until interrupted by the digitalized voice message, the microphone input or the alarm silence mode as specified. Each slow whoop cycle shall last approximately four (4) seconds. The tone generator shall be single channel with an automatic backup generator per channel such that failure of the primary tone generator causes the backup generator to automatically take over the functions of the failed unit and causes transfer of the common trouble relay.

E. Protection Circuits: Each amplifier shall be constantly supervised for any condition that could render the amplifier inoperable at its maximum output. Failure of any component shall cause automatic transfer to a designated backup amplifier, illumination of a visual "amplifier trouble" indicator on the control.

2.4 FIRE DETECTORS

A. Photoelectric light scattering type smoke detectors shall be provided as follows:

1. The detector shall be suitable for two-wire 24VDC operation and two-way communications on the intelligent analog signaling circuit. Smoke detectors shall be U.L. listed for use with the FACP and environmental conditions
2. Detectors shall be self-compensating for ambient temperature and humidity
3. Detector bases shall be installed on an industry standard, 4 inch (101 mm) square or octagonal electrical outlet box. Bases shall be universal for ionization, heat, and photoelectric (light scattering type) detectors.
4. Detectors shall be twist lock type on to the base with self-wiping contacts.
5. Screw clamp terminals shall be provided for all conductor terminations
6. The detector shall be addressed to identify each detector, type, its location within the system, and its sensitivity setting.
7. Provide self-restoring type detectors that do not require any readjustment after actuation to restore them to normal operation.
8. All components shall be rust and corrosion resistant. Vibration shall have no effect on the detector's operation. Protect the detection chamber with a fine mesh metallic screen that prevents the entrance of insects or air born materials. The screen shall not inhibit the movement of smoke particles into the chamber.
9. The detector shall display a steady LED when in the alarm state when the system is operating from normal or standby power.
10. Where selective localized control of electrical devices is required for interfaced equipment operation, furnish and install a base with software programmed addressable relay integral to the base.

B. Photoelectric - Beam Type:

1. Detectors shall be U.L. listed for use with the fire alarm control panel and environmental conditions.
2. Detectors with active receivers are required.
3. Field programmable sensitivity settings of 20%, 35%, and 60% beam obscuration.
4. Latching alarm LED is built into the cover of the receiver or transmitter.
5. Compensation circuit for environmental variations.
6. Tied directly into an FACP control board. Remote panels are not permitted.

C. Duct Detectors:

1. Duct smoke detectors shall meet the requirements for photoelectric light scattering type detectors. With the addition that duct detectors are U.L. 268A listed for installation in air duct sampling housings for the detection of smoke in HVAC system ducts.
2. Provide remote indication where the detector is obstructed or not visible from the floor level.
3. Provide a remote test station where the detector is more than six feet above floor level. An operating key switch shall initiate an alarm test.
4. Weatherproof Enclosure: NEMA 250, Type 4X; NRTL Listed for use with the supplied detector for smoke detection in HVAC system ducts.
5. Sampling Tubes: Design and dimensions as recommend by the manufacturer for the specific duct size, air velocity, and installation conditions where installed.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

D. Heat Detectors:

1. Detectors shall be Listed or Approved for use with the FACP and environment conditions.
2. Detectors shall be addressed, tested and programmed prior to installation.
3. Detectors shall display a steady LED when in the alarm state when the system is operating from normal or standby power.
4. Detectors shall be equipped with screw terminals for each conductor.
5. Detectors shall be hermetically sealed and of the automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise.
6. Detector operation shall not be subject to thermal lag.
7. Heat detectors in hoistways and elevator machine rooms shall be intelligent, low temperature (135ºF-140ºF), rate-compensating detectors.

2.5 MANUAL PULL STATIONS:

A. Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
B. Provide double action addressable manual stations where shown on the drawings, to be flush or surface mounted as required. Manual stations shall be addressable.
C. Stations shall be equipped with terminal strip and pressure-style screw terminals for the connection of field wiring. Stations that require the replacement of any portion of the device after activation are not permitted. Stations shall be finished in fire engine red with

molded raised lettering operating instructions of contrasting color. The use of a key or wrench shall be required to reset the station.

2.6 GRAPHIC ANNUNCIATOR

A. The existing fire alarm graphic annunciator is existing to remain.

2.7 REMOTE MONITORING SYSTEM

A. The existing remote monitoring system is existing to remain.

2.8 POWER SUPPLIES

A. Primary power for the FACP shall be 120VAC service obtained from the emergency power panel board. Red colored breaker locks shall be provided for all fire alarm circuit breakers. Contractor shall be responsible for identifying any temporary power connections required during the installation.

B. Secondary power for the FACP shall be provided by sealed gelled electrolyte batteries. Batteries shall be housed in the control cabinet or a separate cabinet with adequate cell separation to prevent accidental discharge.

C. Battery Capacity: Battery supply shall be calculated to operate its load in a supervisory mode for twenty-four hours with no primary power applied, and after that time, operate its alarm mode for five minutes. In addition, an alarm reserve correction of 1.3 shall be included.

D. Battery Charger: Secondary power battery chargers shall be obtained from the emergency power panel board. Provide battery-charging circuitry for each standby battery bank in the system low voltage power supply or as a separate circuit. The charger shall be automatic in design, adjusting the charge rate to the condition of the batteries. Battery charge rate and terminal voltage shall be read using the fire alarm control panel LCD display in the service mode, indicating directly in volts and amps. Charger shall be housed in the main fire alarm control panel or the battery cabinet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment, materials, installation, workmanship, examination, inspection, and testing shall be in accordance with NFPA 72, except as modified herein.

3.2 PRIMARY POWER

A. Make the service connection for the FACP at the emergency distribution panel where shown. Provide a separate NEMA 1 "General Purpose Enclosure" for the circuit breaker. The circuit breaker enclosure shall be painted red, marked "FACP", and provided with a lockable handle or cover.

3.3 SYSTEM FIELD WIRING AND CONDUIT

A. Wiring within Cabinets and Junction Boxes: Provide wiring installed in a neat and

workmanlike manner and installed parallel with or at right angles to the sides and back of any box or cabinet.

B. Conductor Type and Size: Wire size shall be sufficient to prevent dropping voltage below specified minimum levels. Wire type and sizing of conductors shall also be in accordance with the manufacturer's wiring specifications. Minimum wire size and type shall be as follows, unless manufacturer's requirements conflict. Conflicts shall be brought to the attention of the COTR and OSHEM:

1.	Signaling Line Circuits:	16AWG, Type FPLP, solid copper
2.	Notification Appliance Circuits:	14AWG, Type FPLP, solid copper, twisted pair
3.	120VAC Circuits:	12AWG, Type THHN, solid copper
4.	Interfaced Circuits:	16AWG, Type FPLP, solid copper
5.	Speaker Circuits:	16 AWG, Type FPLP, solid copper, twisted pair
6.	Battery Cable:	14 AWG, solid copper
7.	Network:	16 AWG, Type FPLP, solid copper, twisted pair, 2-hour rated cable system.
8.	Audio Riser:	16 AWG, Type FPLP, solid copper, twisted pair, 2-hour rated cable system

C. Connectors: All conductors shall be terminated at a screwed connector on a securely mounted approved pressure-type terminal block. The use of wire nuts or similar devices shall be prohibited.

D. Terminal Cabinets: Provide a terminal cabinet at the base of any circuit riser, on each floor at each riser, and where indicated on the drawings. Cabinet size shall be appropriate for the size of the wiring to be connected.

E. Conductor Numbering: All conductors installed in the system shall be numbered at every junction point. Use a numbered shrink-wrap label designed specifically for this purpose. Wire numbers shall be the same as those designated on the as-built drawings. Mark each terminal in accordance with the wiring chart and diagrams of the system.

F. Conductor Color Coding: Color coded conductors shall be consistent for each type of circuit. When renovating or adding to an existing system, color-coding shall match the existing system.

G. Junction Boxes: Any junction/gang box used in a circuit shall sole be dedicated to that circuit. A common junction/gang box is not permitted for routing multiple circuits.

H. Signaling Line and Notification Appliance Circuits

1. Signaling Line, notification appliance, and power circuits shall each be in separate conduit.

2. Strobes are to be connected to circuits separate from speakers. This includes strobes and speakers that are mounted as a unit.

3. Provisions for tying-in signaling line and notification appliance circuits directly to the FACP mother board (board containing CPU) shall not be used. Initiation and indicating

circuits shall be tied to a separate electronic board before connection to the motherboard.

I. Circuit Loading

1. Spare capacity shall be in accordance with Article 1.5.E.

2. Circuits operating at 24VDC shall not operate at less than 21.6 volts. Circuits operating at any other voltage shall not have a voltage drop exceeding 10% of nominal voltage.

J. Spare Circuits: Provide one spare signaling line and notification appliance circuit for each terminal box placed at each floor on each riser. Spare capacity shall also be provided in the FACP for these circuits. FACP control boards shall be provided to permit two spare initiation circuits and two spare indicating circuits. Spare circuits are not to include those provided on the motherboard.

K. Conduit

1. All conductors shall be in grounded metal conduit. Conduit shall be rigid metal or EMT. Flexible metal conduit not exceeding six-foot lengths shall be permitted from junction box to initiating device. On flexible metal conduit, use only insulated throat connectors.

2. Run conduit or tubing concealed unless specifically shown otherwise on the drawings.

3. Minimum conduit size shall be 3/4-inch.

L. Circuits to Interfaced Equipment

1. Circuits to smoke management systems, fan shutdown systems, door locking systems, A/V shutdown, fire door release, and firefighter telephones in elevator cabs shall terminate in terminal cabinets within 914mm (3 feet) of the controllers for those systems. The completion of those circuits from the terminal cabinets to the appropriate system shall be provided under the appropriate division specification.

M. Load Control Relays

1. Where required by NFPA 101, relays shall be located within three feet of the device controlled.

3.4 FIRESTOPPING

A. Seal all holes caused by penetrating conduit, piping, or other penetrations that pass through floors, walls or ceilings. Firestop penetrations through floor slabs, fire-rated walls, shafts, or any fire-rated assembly in accordance with Section 078413, Penetration Firestopping.

3.5 MARKING

A. All metal surfaces shall be painted. Metal conduit in finished areas shall be painted the color to match adjacent surfaces. Junction boxes in unfinished areas shall be painted full gloss enamel red.

B. Red bands shall be applied every 10 feet (3.05m) when not using red-colored conduit.

C. Prior to acceptance testing each fire alarm initiating and notification device must be labeled with the device address.

D. Device coverage maps shall be provided adjacent to each aspirating smoke detection unit. Maps shall mark the coverage area of each pipe on the detection unit. Maps shall be sized at 11”x17” minimum.

3.6 DEVICE INSTALLATION

A. FACP: Locate the FACP where indicated on the drawings. Surface mount the enclosure with the LCD display located between 5 feet and 6 feet (1829 mm) above the finished floor or center the cabinet at 5.5 feet, whichever is lower.
B. Manual Pull Stations: Mount the manual pull stations so that their operating handles are 4 feet (1219 mm) above the finished floor.
C. Smoke Detectors:

1. In raised floor spaces and high-velocity plenum areas, the smoke detectors shall be installed to protect 225 sq. ft (145161 sq. mm) per detector.
2. Detectors shall be installed in elevator machine rooms and elevator hoistways.
3. Install smoke detectors a minimum of 3 feet (914 mm) away from supply air vents.
4. New smoke detectors shall be installed with dust covers. The dust covers shall be removed just prior to acceptance testing.
5. The indicating LED on the smoke detector shall be visible from the floor. Where ceiling conditions prevent easy viewing of the LED from the floor, a remote indicating lamp must be installed.

F. Heat Detectors for Elevator Rooms and Shafts: Heat detectors, provided to meet ANSI A17.1 requirements for elevator power disconnect, shall be located within 2 feet of each sprinkler head.

3.7 TESTS

A. Test Equipment: The contractor shall supply personnel, communication devices, and all equipment necessary for performance of the final test.

B. Megger Tests: After all wiring has been installed, and prior to making any connections to panels or devices, all wiring shall be megger tested for insulation resistance, grounds, and/or shorts. Conductors with 300 volt rated insulation shall be tested at a minimum of 250 VDC. Conductors with 600 volt rated insulation shall be tested at a minimum of 500 VDC. The tests shall be witnessed by OSHEM, SI Life Safety Group, and the Contracting Officer and test results recorded for use at the final acceptance test.

C. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Contracting Officer, OSHEM and the SI Life Safety Group. Test results shall be recorded for use at the final acceptance test.

D. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are

functioning properly. After preliminary testing is complete, provide a letter to the COTR certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly, including proper device message descriptions and proper placement of graphic icons in fire alarm systems with graphic notification equipment. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.

A. Final Acceptance: Notify the Contracting Officer in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. A final acceptance test will not be scheduled until megger test results, the loop resistance test results, preliminary testing letter, and the submittals required in Part 1 are provided to the Contracting Officer. Test the system in accordance with the procedures outlined in the NFPA 72 and as follows

1. Verify the absence of unwanted voltages between circuit conductors and ground

2. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.

3. Complete operational tests under emergency generator power

4. Complete operational tests under battery power and as described above under battery power. Test the battery charger.

5. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.

6. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturers operating and maintenance manual.

7. Verify several of the audibility [and intelligibility] results that were recorded on the as-built drawings as part of the preliminary testing above.

8. Visually inspect all wiring.

9. Verify that all software control and data files have been entered or programmed in the FACP.

10. Verify that shop drawings reflecting as-built conditions are accurate.

11. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.

12. Measure voltage readings for circuits to assure that voltage drip is not excessive.

13. Measure the voltage drop at the most remote appliance on each notification appliance circuit.

14. All faults and trouble signals associated with the completed work must be cleared from the panel.

3.8 TRAINING

A. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing and maintenance of the system provided. The instructor shall train the Smithsonian employees designated by the Contracting Officer, in the care, adjustment, maintenance, and operation of the fire alarm system.

B. Training sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the COTR.

C. Required Instruction Time: Provide 16 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the Contracting Officer. The instruction may be divided into two or more periods at the discretion of the Contracting Officer. One training session shall be videotaped by the contractor. Videotapes shall be delivered to the COTR.

D. Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory and trouble. The instructions shall be approved by the COTR.

E. Comprehensive system troubleshooting training shall be provided for a single individual designated by the COTR. This session shall be separate and distinct from the above-described sessions.

F. All training sessions shall be conducted following final system certification and acceptance. Three additional training sessions shall be provided for all security personnel on all shifts six months after final system certification.

G. All training sessions shall be conducted by an authorized fire alarm system distributor representative, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided.

3.9 KEYS

A. Keys and locks for all equipment shall be identical where possible. Provide not less than five keys of each type required. Identify keys by an appropriate number stamped on each key or on a metal tag attached thereto. Provide a key numbering chart in each operation and maintenance manual furnished.

END OF SECTION 283111

SECTION 285119 – CONTROL ROOM AND MONITORING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 280500.10 Common Work Results for Electronic Security.

1.2 SYSTEM DESCRIPTION

A. The Control Room and Monitoring Equipment is for monitoring the entire electronic security systems (ESS).

1.3 SUMMARY

A. This Section includes the following:

1. Console Equipment
2. Video Intercom Master

1.4 REFER TO 280500.10 FOR ALL OTHER PART I REQUIREMENTS

PART 2 - PRODUCTS

2.1 SECURITY CONSOLE

A. Acceptable Manufacturers

1. Middle Atlantic
2. Approved Equivalent

B. Middle Atlantic ViewPoint Series VC-LS7219-DT37 or approved equivalent

C. Required Accessories

1. Middle Atlantic ViewPoint VC-B24-FB Rear Fan Door, 100 CFM (two per station)
2. Middle Atlantic ViewPoint VC-2419ST Sliding CPU Tray (two per station)
3. Middle Atlantic ViewPoint MM3-2X1BLK Dual Monitor Mount (two per station)
4. Middle Atlantic ViewPoint PD-815SC Powerstrip (Two per station)
5. Middle Atlantic ViewPoint VPLSSP-VAR sit-stand side panel

D. Minimum Features and Specifications

1. Sit / Stand Capability
2. 69 inch wide work surface
3. 72 inch wide base
4. 37 inch depth worksurface
5. Height range: 30.47” (774 mm) to 55.60” (1412 mm)
6. Flexible cable management channel
7. Metal parts shall have a lifetime warranty
8. Construction: Welded steel bays
9. Three user-definable memory settings for height
10. Electric Lift Mechanism shall have a weight capacity of 540 pounds per pair and a minimum of two-year warranty
11. Articulating monitor mounts to accommodate the quantity and size of monitors indicated on the drawings
12. GREENGUARD Indoor Air Quality Certified for Children and Schools
13. Front and rear removable panels
14. Rear panels with integrated fans
15. ViewPoint CPU Tray
16. Task lights
17. Finished side panel at end of rows
18. 12 inch non-rising bridge between front row of consoles
19. Owner shall select finishes, coordinate at least 30 days prior to ordering

2.2 TECHNICAL FURNITURE

A. Acceptable Manufacturers

1. Middle Atlantic
2. Approved Equivalent

B. Middle Atlantic Contour Freedom Chair Series CHAIR-CF1-B or approved equivalent

C. Minimum Features and Specifications

1. Headrest: Dynamic, position-sensitive headrest adjusts to cradle your head and neck as you recline. Automatically moves out of the way when you sit upright.
2. Cushions: Technogel Cushions are sculpted to closely follow body contours-provide comfort and maximize weight distribution.
3. Armrest: Technogel armrests move up and down together and stay with you as you recline, always keeping you in supported balance.
4. Backrest: Pivoting responsive backrest automatically adapts to the changing needs of your spine as you recline. With the counter-balance mechanism, your weight automatically balances the force required to recline the chair.
5. Weight Capacity: 300 lbs.
6. Recommended Use: 3 shift, 24/7 heavy use durability.
7. Overall Dimensions: 27.25” W x 25” D x 53” H.
8. Seat dimensions: 21”W x 16.25-18.5”D x 16"-21"H.
9. Distance between armrests: 11.5" - 21.5".
10. Backrest dimensions: 21" W x 18-21" H.
11. Warranty shall be 15 years on mechanicals, based on 24/7, 365 day use: 5 year warranty for cushions and casters

2.3 VIDEO INTERCOM MASTER

A. Acceptable Manufacturers

1. Vingtor-Stentofon
2. Approved Equivalent

B. Vingtor-Stentofon (1490001010) ITSV-2 with adapter plate or approved equivalent

C. Minimum Features and Specifications

1. Video desktop intercom supporting ICX-Alphacom, SIP, and IC-EDGE solutions
2. 12.7 cm (5 in) capacitive 5-point touchscreen HD TFT LC
3. Built-in Bluetooth
4. Dual-mic HD speakerphone with noise reduction
5. Video Resolution: Up to 720p
6. Video frame rate: Up to 30 fps
7. Power over Ethernet 802.3af Class 3, 802.3at, Class 4

PART 3 - EXECUTION

3.1 GENERAL

A. Install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, ANSI C2 and furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified. Install control signals, communications, and data transmission lines grounding as necessary to preclude ground loops, noise, and surges from affecting system operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with manufacturers' recommendations and as modified herein.

B. Furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable duress communications system.

C. Consult the manufacturers' installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

3.2 REFER TO 280500.10 AND 281000 FOR ALL OTHER PART III REQUIREMENTS

END OF SECTION 285119

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. See Utility specifications for additional information on utility abandonment requirements.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, removing site utilities and abandoning site utilities in place.
7. Temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

C. Camera inspection of existing stormwater and sewer utility.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect/Owner.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.

D. Utility Locator Service: Notify Miss Utility for area where Project is located before site clearing. Contractor responsible for hiring utility locator to survey areas on site (private property).

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

I. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material:

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 1372 mm (54 inches) above the ground.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3. TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site.

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

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities to be removed or abandoned in place.

1. Arrange with utility companies to shut off utilities where applicable.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect/Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's/Owner's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

E. Removal of underground utilities is included in Division 21, Division 22, Division 23, Division 26, Division 27, and Division 28 Sections.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots, obstructions, and debris to a depth of 450 mm (18 inches) below exposed subgrade.
3. Use only hand methods for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 200 mm (8 inches), and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 150 mm (6 inches) in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects more than 50 mm (2 inches) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 1800 mm (72 inches). No stockpiling shall be placed outside the project limits.
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

3.9 CLOSING ABANDONED UTILITY SYSTEMS

A. Abandoned Piping
1. All existing utilities to be abandoned shall be removed in their entirety or capped and filled with flowable fill.
2. Only when approved by the Owner, close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

a. Close open ends of piping with at least 200mm (8”) thick, brick masonry bulkheads.

b. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Structures: Excavate around structure as required and use either procedure below:

1. Remove structure and close open ends of remaining piping.
2. Remove top of structure down to at least 900mm (36") below final grade. Fill to within 300mm (12") of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
3. Backfill to grade according to Division 31 Section "Earthwork."

END OF SECTION 311000

SECTION 312317 - TRENCHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities.
2. Backfilling and compaction.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand- Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.4 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.5 SUBMITTALS

A. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

B. Product Data: Submit data for geotextile fabric indicating fabric and construction.

C. Materials Source: Submit name of imported fill materials suppliers.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with State and local standards.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Subsoil Fill: Type as specified and noted on plans**.**

PART 3 EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated on Drawings.

1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Maintain grade alignment of pipe using string line parallel with grade line and vertically above centerline of pipe.

1. Establish string line on level batter boards at intervals of not more than 25 feet (7.5 meters).
2. Install batter boards spanning trench, rigidly anchored to posts driven into ground on both sides of trench.
3. Set three adjacent batter boards before laying pipe to verify grades and line.
4. Determine elevation and position of string line from elevation and position of offset points or stakes located along pipe route.
5. Do not locate pipe using side lines for line or grade.

3.2 PREPARATION

A. Call Local Utility Line Information service not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, and other features remaining as portion of final landscaping.

D. Protect bench marks, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

3.3 TRENCHING

A. Excavate subsoil required for utilities to utility service.

B. Remove lumped subsoil, boulders, and rock up of 1/6 cubic yard (0.13 cu m), measured by volume.

C. Perform excavation within 24 inches (600 mm) of existing utility service in accordance with utility's requirements.

D. Do not advance open trench more than 200 feet (60 meters) ahead of installed pipe.

E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.

F. Excavate bottom of trenches maximum 2 feet (600 mm) wider than outside diameter of pipe.

G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.

H. When Project conditions permit, slope side walls of excavation starting 2 feet (600 mm) above top of pipe. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.

I. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered.

J. Cut out soft areas of subgrade not capable of compaction in place. Backfill with suitable material and compact to density equal to or greater than requirements for subsequent backfill material.

K. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

L. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

M. Remove excess subsoil not intended for reuse, from site.

N. Stockpile subsoil in area designated on site to depth not exceeding 8 feet (2.5 m) and protect from erosion.

3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent

properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet (1500 mm) deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation work.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Place fill material in continuous layers and compact.

D. Maintain optimum moisture content of fill materials to attain required compaction density.

E. Do not leave any trench open at end of working day.

3.6 FIELD QUALITY CONTROL

A. Perform laboratory material tests in accordance with ASTM D1557.

B. Perform in place compaction tests in accordance with the following:

1. Density Tests: ASTM D1556, ASTM D2167**,** or ASTM D2922.
2. Moisture Tests: ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.7 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION 312317

SECTION 312323 - FILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of soil compaction work includes, but is not limited to the following:
   1. Requirements for soils and backfill materials consolidation and compaction under buildings, structures, pavement, trench backfill, or other bearing components of the project.

B. It is the Contractor's responsibility to coordinate, schedule and manage the necessary inspections required for the project.

C. The Owner will pay for necessary geotechnical testing and inspection during project operations.

1.3 QUALITY ASSURANCE

A. Testing and inspection shall be performed by a qualified independent testing laboratory, under the supervision of a registered professional engineer specializing in soils engineering.

B. The taking of samples and the performing of field compaction density tests and laboratory maximum density tests shall be done for the Contractor by an approved independent testing laboratory.

C. Determine optimum moisture content of various soil and granular materials in accordance with ASTM D1557, Modified Proctor Tests.

D. Provide on-site at least one person who shall supervise the soil compaction operations, and who shall be thoroughly familiar with the various types of compaction equipment, proper compacting techniques and methods, and soils behavior, and who shall direct the compaction operations.

E. It is the responsibility of the Contractor to select, furnish and properly maintain equipment that will compact the fill uniformly to the required density.

F. Compacted soils not meeting compaction densities shall be re-excavated, re-compacted, and re- tested until all requirements are met. All costs of testing shall be borne by the Contractor.

1.4 SUBMITTALS

A. The results of the laboratory maximum density tests, certified by the testing laboratory for the various soil and granular materials utilized on the job.

B. All laboratory and field compaction test and re-test reports.

1.5 JOB CONDITIONS

A. Compaction shall not take place in freezing weather or when materials to be compacted are frozen, too wet or moist, or too dry.

B. Schedule the work to allow ample time for laboratory tests and to permit the collecting of samples and the performing of field density tests during the backfilling operations.

C. Protect pipes, structures, and all other subsurface work from displacement or injury during compaction operations.

D. All operations under this section of the specifications will be subject to continuous inspection by the Owner's Representative and a soils testing laboratory. The Owner's Representative and the testing laboratory will determine and be the sole judge of the conformance of materials, workmanship, and compaction with the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 COMPACTION

A. Utilize the proper compaction methods and equipment to suit the soils and conditions encountered.

2.2 LABORATORY TEST REPORTS

A. As a minimum, the laboratory maximum density testing reports shall contain the following:
1. Laboratory's name.
2. Date, time, and specific location from which sample was taken and name of person who collected the sample.
3. Moisture - Density Curve plotted on graph paper to as large a scale as is practical with all points used to derive the curve being clearly visible.
4. Designation of the test method used.
5. The optimum density and moisture content.
6. A description of the sample.
7. The date the test was performed and the person who performed the test.
8. The project name, identification, and contractor's name.
9. The signature of a responsible officer of the testing laboratory certifying to the information contained in the report.

B. As a minimum, the field compaction density testing reports shall contain the following:
1. Date, time, depth, and specific location at which the test was made and the person's name who performed the test.
2. Designation of the test method used.
3. Designation of the material being tested.
4. Test number.
5. In-place dry density and moisture content.
6. Optimum density and moisture content.
7. Percentage of optimum density achieved.
8. The signature of a responsible officer of the testing laboratory certifying to the information contained in the report.

2.3 OTHER MATERIALS

A. All other materials which are required to achieve adequate compaction shall be as selected by Contractor subject to approval of Owner's Representative.

PART 3 - EXECUTION

3.1 INSPECTION

A. If available, review geotechnical report for any recommendations regarding compaction.

B. Verify that layers of material are no thicker than the maximum thicknesses specified in other Sections.

C. Verify that moisture content is nearly optimum.

D. Do not begin compaction operations until conditions are satisfactory.

3.2 PERFORMANCE

A. Compaction densities shown are percentages of the maximum density obtainable at optimum moisture content as determined by ASTM D1557; Method C.

B. Uniformly spread each layer. Moisten or dry each layer of material to achieve optimum moisture content. Unless otherwise specified or directed by Owner's Representative, compact each layer of material to the following required densities:

Location	Percentage of Modified Proctor Test Density
Pipe, Pavement and Structure Backfill	98%
All other backfill areas.	90%

3.3 FIELD QUALITY CONTROL

A. Perform a laboratory maximum density test for each type of soil proposed for use or encountered in the work. Determine optimum moisture content in accordance with ASTM D1557.

B. Field density tests may be ordered by the Owner's Representative at his discretion and at a minimum in accordance with the following average frequencies:
1. General: One test for each type of fill and at each change in material or supplier.
2. Foundations, Utility Trench and Footings: One test for compacted fill material at intervals of approximately 50 lineal feet along bearing walls or trenches.
3. Under Structures and Slabs: One test for every 2,500 square feet of compacted fill or backfill, but not less than two tests per lift.
4. Pavement and Mass Fill Areas: One test per 5,000 square feet of fill or backfill but not less than two per lift.

C. Field density and moisture testing shall conform to the requirements of ASTM D1556 (sand core) or D2922 and ASTM D3017 (nuclear density). Soils shall be described in accordance with ASTM D2488, Visual-Manual Procedure.

D. If materials fail to meet its specified compaction, grading, etc., the Contractor shall remove, replace and retest the material until the specified parameters are achieved.

E. The Contractor is responsible for any re-testing costs.

3.4 COORDINATION

A. Provide all assistance and cooperation during testing and coordinate operations to allow ample time for the required sampling and testing. It is the Contractor's responsibility to coordinate all testing required.

END OF SECTION 312323