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Project Name:	NIFC 100 Administration Repairs FY 2022 GAOA
Location:	Boise, ID
Project Number:	070117.028
Contract Number:	140L0622D0002

LBYD Federal, LLC

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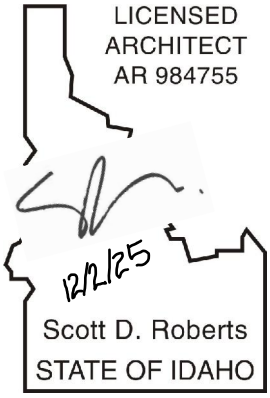
ARCHITECTURAL DESIGNER OF RECORD:



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Responsibility limited to the following sections in the project specifications:

011000	SUMMARY
012200	UNIT PRICES
013100	PROJECT MANAGEMENT AND COORDINATION
013200	CONSTRUCTION PROGRESS DOCUMENTATION
013300	SUBMITTAL PROCEDURES
014000	QUALITY REQUIREMENTS
014200	REFERENCES
015000	TEMPORARY FACILITIES AND CONTROLS
016000	PRODUCT REQUIREMENTS
017300	EXECUTION REQUIREMENTS
017320	SELECTIVE DEMOLITION
017329	CUTTING AND PATCHING
017419	CONSTRUCTION WASTE MANAGEMENT
017700	CLOSEOUT PROCEDURES
017823	OPERATION AND MAINTENANCE DATA
017839	PROJECT RECORD DOCUMENTS
017900	DEMONSTRATION AND TRAINING

Responsibility limited to the following sections in the project specifications:

024200	REMOVAL AND SALVAGE OF CONSTRUCTION MATERIALS
061000	ROUGH CARPENTRY
072100	THERMAL INSULATION
079200	JOINT SEALANTS
081113	HOLLOW METAL DOORS AND FRAMES
081416	FLUSH WOOD DOORS
083113	ACCESS DOORS AND FRAMES
087111	DOOR HARDWARE (DESCRIPTIVE SPECIFICATION)
088000	GLAZING
092216	NON-STRUCTURAL METAL FRAMING
092900	GYPSUM BOARD
095113	ACOUSTICAL PANEL CEILINGS
096513	RESILIENT BASE AND ACCESSORIES
096519	RESILIENT TILE FLOORING
096813	TILE CARPETING
099123	INTERIOR PAINTING
099300	STAINING AND TRANSPARENT FINISHING
101423.16	ROOM-IDENTIFICATION PANEL SIGNAGE
104413	FIRE PROTECTION CABINETS
104416	FIRE EXTINGUISHERS

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230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230523	GENERAL-DUTY VALVES FOR PLUMBING AND HVAC PIPING
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230549	SEISMIC CONTROLS FOR PLUMBING AND HVAC
230553	IDENTIFICATION FOR PLUMBING AND HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING AND BALANCING FOR HVAC
230700	PLUMBING AND HVAC PIPING INSULATION
230900	INSTRUMENTATION AND CONTROL FOR HVAC
232300	REGRIGERANT PIPING
233113	METAL DUCTS
233300	AIR DUCT ACCESSORIES
233713	DIFFUSERS, REGISTERS, AND GRILLES
238129	VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

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260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533.13	CONDUITS FOR ELECTRICAL SYSTEMS
260533.16	BOXES AND COVERS FOR ELECTRICAL SYSTEMS
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
260800	ELECTRICAL COMMISSIONING
260923	LIGHTING CONTROL DEVICES
262726	WIRING DEVICES
262813	FUSES
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
262913.03	MANUAL AND MAGNETIC MOTOR CONTROLLERS
265119	LED INTERIOR LIGHTING
265213	EMERGENCY AND EXIT LIGHTING
271513	COMMUNICATIONS COPPER HORIZONTAL CABLING
281000	ACCESS CONTROL

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Responsibility limited to the following sections in the project specification:

211313	FIRE SPRINKLER SYSTEM
283100	ADDRESSABLE FIRE-ALARM SYSTEMS

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Government Occupancy Requirements.
5. Specification and Drawing conventions.

1.2 PROJECT INFORMATION

A. Project Identification: NIFC 100 – Administration Repairs FY 2022 GAOA

1. Project Location: National Interagency Fire Center, NIFC 100-ADM, 3906 S. Vista Ave. Boise, ID 83705, on the NIFC Campus at 3833 S Development Ave Boise, ID 83705.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

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

B. Work effort includes the demolition and renovation of portions of Building 100 with new office and support spaces, and the addition of two external stair towers. All other work is as delineated within these contract documents.

C. Type of Contract:

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

1.4 ACCESS TO SITE

A. Contractor shall have limited use of premises for construction operations as indicated by the Work on Drawings.

B. Schedule operations so that Work is conducted during regular office hours which are 8:00 am to 4:30 pm. Work during nights or weekends may be allowed as approved by the Government.

C. Schedule and sequence operations necessary to complete the work, including coordination with other crafts relative to the Contractor's requirements. Schedule Work in such manner as to avoid delays in overall construction and permit proper installation of work.

1. A two week pause in construction will be required to enable the Government to install the vertical portions of Government provided modular furniture. Once installed, the contractor may resume work and will need to pull communication lines to modular furniture and wire the electrical portion of power columns.

D. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Government Occupancy: Allow for Government occupancy of Project site. Government personnel will be continuously occupying areas of the building immediately adjacent to the work area. Conduct work in a manner that will minimize needs for disruption of normal Government operations. Provide minimum 72 hours advance notice to Government of activities that will impact normal Government operations. Secure Government's written approval of activities that will impact normal Government operations to avoid delays in overall construction and permit proper installation or work.
2. Driveways and Entrances: Keep driveways parking areas, loading areas, and entrances serving premises clear and available to Government, Government employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

E. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

F. Utilities: Service interruptions of mechanical and electrical systems will be allowed for short periods per schedule approved by Government.

1.5 SECURITY

A. NIFC is a secure facility, and all Contractor personnel shall provide an official US Government or State Government issued photo identification at the security gate upon entry.

B. All contracting personnel shall wear NIFC furnished visitor badges in a visible location at all times while on the facility, and return the badge at the end of each day or at the completion of the project.

C. Contractor shall provide a list of names, to the Government, of all personnel that will be working on the facility.

D. Contractor personnel shall not enter the facility more than 30 minutes prior to the start of scheduled work day and must leave the facility within 30 minutes of the scheduled completion time.

1.6 GOVERNMENT OCCUPANCY REQUIREMENTS

A. Full Government Occupancy: Government will continue to occupy the building during construction. Cooperate with Government during construction operations to minimize conflicts. Perform the Work so as not to interfere with Government day-to-day operations in adjacent spaces in the building and surrounding building site. Maintain existing exits, unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Government and authorities having jurisdiction.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 33-Division format and CSI/CSC's "MasterFormat" numbering system.

1. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

C. Terminology: In Divisions 02 through 31 Specification Sections, all references to "Owner" have been replaced with the term "Government" or "Government" (when referring to the person acting for the Government). All references to "Architect" have been replaced with the term "Government".

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES AND SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

1.2 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Application for Payment and Contractor's Construction Schedule.
2. Submit the Schedule of Values to Government at earliest possible date but no later than 10 calendar days after the Notice to Proceed.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

   a. Project name and location.
   b. Name of Government.
   c. Contractor's name and address.
   d. Date of submittal.

2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items under required principal subcontracts for operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training in the amount of 5 percent of the Contract Sum.
3. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
4. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
5. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

6. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

7. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Modifications result in a change in the Contract Sum.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LUMP SUM PAYMENT ITEMS

A. Payment items for the work of this Contract for which contract lump sum payments will be made are listed in the BIDDING SCHEDULE and described below.

B. All costs for items of work, which are not specifically mentioned to be included in a particular lump sum or unit price payment item, shall be included in the listed lump sum item most closely associated with the work involved.

C. The lump sum price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for which separate payment is not otherwise provided. Items will be paid for as a lump sum by percent of item completed in accordance with the accepted Schedule of Values.

D. Mobilization and Demobilization: Preparatory work and operations, including movement of personnel, equipment, supplies and incidentals to the project site; and for other work and operations that must be performed or costs incurred prior to beginning work on the various items on the project site. Does not include moves between project sites.

    1. Payment: Payment will be made for costs associated with mobilization and demobilization, as defined in Special Clause PAYMENT FOR MOBILIZATION AND DEMOBILIZATION. No direct payment for moves between project sites will be made. Include consideration for moves between project sites. Prices and payment will be full compensation for the work described in this Section. Progress payments will be made as follows:

        a. When 5 percent of the original Contract amount is earned from other bid items, 50 percent of the amount bid for mobilization or 5 percent of the original Contract amount, whichever is lesser, will be paid.
        b. When 10 percent of the original Contract amount is earned from other bid items, 100 percent of the amount bid for mobilization or 10 percent of the original Contract amount, whichever is lesser, will be paid.

c. Upon completion of work for the project, payment of the amount bid for mobilization in excess of 10 percent of the original Contract amount, will be paid.
d. The total sum of all payments shall not exceed the original Contract amount bid for mobilization, regardless whether Contractor may have shut down the work on the project or moved equipment away from the project and then back again.

2. Unit of Measure: Lump sum.

E. Demolition:

1. Payment: Payment will be made for costs associated with operations necessary for demolition.
2. Unit of Measure: Lump sum.

F. Construction:

1. Payment: Payment will be made for costs associated with operations necessary for the construction.
2. Unit of Measure: Lump sum.

3.2 SUMMARY OF BID ITEMS

A. The intent of the following paragraphs is to explain, in general, what is and what is not included in a bid item, and the limits or cut-off points where one bid item ends and another begins. If no bid item exists for a portion of the work, include the costs in a related bid item. Include separate labor and materials costs for each bid item.

B. BID ITEM 1 - GENERAL REQUIREMENTS (MOBILIZATION AND CONSTRUCTION MANAGEMENT)**:** This item includes all preparatory work and operations, including those necessary to the movement of personnel, equipment, supplies and incidentals to the project site; bonds, work layout; other work and operations which must be performed or costs incurred prior to beginning work on the various items on the project site. Construction management includes ongoing tasks such as environmental controls and field office operations.

C. BID ITEM 2 - EXISTING CONDITIONS (DEMOLITION): This item includes all work required for demolition as shown and specified for the new work.

D. BID ITEM 3 - CONCRETE: This item includes all work related to concrete.

E. BID ITEM 4 - MASONRY: This item includes all work related to masonry.

F. BID ITEM 5 - METALS: This item includes all work related to metal components.

G. BID ITEM 6 - WOOD, PLASTICS, AND COMPOSITES: This item includes all work related concrete.

H. BID ITEM 7 - THERMAL AND MOISTURE PROTECTION: This item includes all work related to thermal and moisture protection of the building envelope, including roofing..

I. BID ITEM 8 - OPENINGS: This item includes all work related to doors, windows, and other openings.

J. BID ITEM 9 - FINISHES: This item includes all work related to interior finishes, paints, and coatings.

K. BID ITEM 10 - SPECIALTIES: This item includes all work related to building specialties.

L. BID ITEM 12 - FURNISHINGS: This item includes all work related to furnishings.

M. BID ITEM 21 - FIRE SUPPRESSION: This item includes all work related to fire suppression systems.

N. BID ITEM 22 - PLUMBING: This item includes all work related to plumbing.

O. BID ITEM 23 – HEATING, VENTILATION, AND AIR-CONDITIONING (HVAC): This item includes all work related to heating, ventilating, and air-conditioning systems.

P. BID ITEM 26 - ELECTRICAL: This item includes all work related to electrical systems.

Q. BID ITEM 27 - COMMUNICATIONS: This item includes all work related to communications systems.

R. BID ITEM 28 – ELECTRONIC SAFETY AND SECURITY: This item includes all work related to electronic safety and security equipment.

END OF SECTION 012200

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination Drawings.
2. Project meetings.
3. Requests for Interpretation (RFIs).

B. See Division 01 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services.

1.2 DEFINITIONS

A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.3 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Government and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

   a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   b. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Government for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
3. Number of Copies: Submit two copies of each submittal. Government will return one copy.
4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

1.5 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Government of scheduled meeting dates and times.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Government, within three days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Government, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments, review required work, project drawings, specifications, construction schedules, payroll, payments, and administrative provisions of the Contract. Be prepared to summarize and explain procedures planned for the project and present specified preconstruction submittals.

1. Attendees: Authorized representatives of Government and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work. The mechanical and electrical subcontractors attendance will be required.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing and long-lead items.
    d. Designation of key personnel and their duties.
    e. Procedures for processing field decisions and Modifications.
    f. Procedures for RFIs.
    g. Procedures for testing and inspecting.
    h. Procedures for processing Applications for Payment.
    i. Distribution of the Contract Documents.
    j. Submittal procedures.
    k. Preparation of Record Documents.
    l. Use of the premises and existing building.
    m. Work restrictions.
    n. Government occupancy requirements.
    o. Responsibility for temporary facilities and controls.
    p. Construction waste management and recycling.
    q. Parking availability.
    r. Office, work, and storage areas.
    s. Equipment deliveries and priorities.
    t. First aid.
    u. Security.
    v. Progress cleaning.
    w. Working hours.

3. Minutes: Record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Government of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

    a. The Contract Documents.
    b. Related RFIs.
    c. Related Modifications.
    d. Purchases.
    e. Deliveries.
    f. Submittals.
    g. Possible conflicts.
    h. Compatibility problems.
    i. Time schedules.
    j. Weather limitations.
    k. Manufacturer's written recommendations.
    l. Warranty requirements.
    m. Compatibility of materials.
    n. Acceptability of substrates.
    o. Temporary facilities and controls.
    p. Space and access limitations.
    q. Regulations of authorities having jurisdiction.
    r. Testing and inspecting requirements.
    s. Installation procedures.
    t. Coordination with other work.
    u. Required performance results.
    v. Protection of adjacent work.
    w. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at regular intervals. Hold the meetings at the project site. Coordinate dates of meetings with preparation of payment requests. Additional progress meetings may be requested by either the Government or Contractor.

1. Attendees: In addition to representatives of Government, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site utilization.
        8) Temporary facilities and controls.
        9) Work hours.
        10) Hazards and risks.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Status of correction of deficient items.
        14) Field observations.
        15) RFIs.
        16) Status of proposal requests.
        17) Pending changes.
        18) Status of Modifications.
        19) Pending claims and disputes.
        20) Documentation of information for payment requests.

3. Minutes: Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.

    a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.6 REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.

1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:

1. Project name.
2. Date.
3. Name of Contractor.
4. Name of Government.
5. RFI number, numbered sequentially.
6. Specification Section number and title and related paragraphs, as appropriate.
7. Drawing number and detail references, as appropriate.
8. Field dimensions and conditions, as appropriate.
9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
10. Contractor's signature.
11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

C. Government's Action: Government will review each RFI, determine action required, and return it. Allow 7 calendar days for Government's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:

   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for coordination information already indicated in the Contract Documents.
   d. Requests for adjustments in the Contract Time or the Contract Sum.
   e. Requests for interpretation of Government's actions on submittals.
   f. Incomplete RFIs or RFIs with numerous errors.

2. Government's action may include a request for additional information, in which case Government's time for response will start again.

D. On receipt of Government's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Government within seven days if Contractor disagrees with response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log monthly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Government.
4. RFI number including RFIs that were dropped and not submitted.
5. RFI description.
6. Date the RFI was submitted.
7. Date Government's response was received.
8. Identification of related bilateral or unilateral modifications, extensions, and changes in scope, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

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

1. Contractor's Construction Schedule.
2. Daily construction reports.
3. Field condition reports.

B. See Division 01 Section "Unit Prices and Schedule of Values" for submitting the Schedule of Values.

1.2 SUBMITTALS

A. Contractor's Construction Schedule: Submit one electronic copy of initial schedule, large enough to show entire schedule for entire construction period.

B. Daily Construction Reports: Submit one electronic copy at weekly intervals.

C. Field Condition Reports: Submit one electronic copy at time of discovery of differing conditions.

1.3 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Modification.

B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Government.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
4. Startup and Testing Time: Include not less than two days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Government's administrative procedures necessary for certification of Substantial Completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work Restrictions: Show the effect of the following items on the schedule:

a. Coordination with existing construction.
b. Limitations of continued occupancies.
c. Uninterruptible services.
d. Use of premises restrictions.
e. Seasonal variations.
f. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 15 days of date established for the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Indicate critical path method from start to finish of project, including contractor float times, if any.

1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. Contract name and number.
2. Contractor representative onsite.
3. Date.
4. High and low temperatures and general weather conditions.
5. List of subcontractors at Project site and work location/classification.
6. Equipment at Project site.
7. Material deliveries.
8. Accidents.
9. Stoppages, delays, shortages, and losses.
10. Meter readings and similar recordings.
11. Orders and requests of authorities having jurisdiction.
12. Services connected and disconnected.
13. Equipment or system tests and startups.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Government, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, Design Computations, and other submittals.

B. See Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule.

C. See Division 01 Section "Quality Requirements" for submitting test and inspection reports.

D. See Division 01 Section "Closeout Procedures" for submitting warranties.

E. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

F. See Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Government's responsive action.

B. Informational Submittals: Written information that does not require Government's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Government reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

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

C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Government's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 14 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Government will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 14 calendar days for review of each resubmittal.

D. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Government.
3. Include the following information on label for processing and recording action taken:

a. Project name.
b. Date.
c. Name and address of Government.
d. Name and address of Contractor.
e. Name and address of subcontractor.
f. Name and address of supplier.
g. Name of manufacturer.
h. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A). Work schedule and value schedules shall be numbers 01000.01 and 01000.02.

i. Number and title of appropriate Specification Section.

j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.
l. Other necessary identification.

E. Cover Sheet:

1. Ensure that cover sheet includes following information:

a. Submittal Number
b. Contract Number
c. Specification Section number and title, paragraph, and complete description of item being submitted. Be specific and clearly identify what is being submitted. When appropriate, reference a specific sheet and detail of the Drawings. Note multiple items individually.
d. Signature and date.
e. Name and telephone number of individual to contact for further information, if other than Contractor.

2. Submitted Information: Link submittal to cover sheet by contract number, project name, and submittal number. Stamp is recommended, but may be hand-written on each copy; ensure submittal stamp includes project name and contract number and blank space in which to write submittal number. Stamp or write this information on all copies.

F. Mechanical and Electrical: Deliver catalogs or pages and tables for mechanical and electrical items in one complete mechanical package and one complete electrical package. Incomplete packages will be retained until all items are received. Shop drawings may be submitted separately. Submit the following additional data:

1. Rough-in data and dimensions.
2. Motor characteristics and wiring diagrams.
3. Performance curves and rated capacities.
4. Operation characteristics.

G. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

H. Additional Copies: Unless additional copies are required for final submittal, and unless Government observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

I. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Government will return submittals, without review received from sources other than Contractor.

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

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "APPROVED."

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

L. Use for Construction: Use only final submittals with mark indicating "APPROVED" taken by Government.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

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

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

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Manufacturer's catalog cuts.
e. Wiring diagrams showing factory-installed wiring.
f. Printed performance curves.
g. Operational range diagrams.
h. Compliance with specified referenced standards.
i. Testing by recognized testing agency.

4. Number of Copies: Submit two copies of Product Data, unless otherwise indicated. Government will return one copies. Mark up and retain one returned copy as a Project Record Document.

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

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

    a. Dimensions.
    b. Identification of products.
    c. Fabrication and installation drawings.
    d. Roughing-in and setting diagrams.
    e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    f. Shopwork manufacturing instructions.
    g. Templates and patterns.
    h. Schedules.
    i. Notation of coordination requirements.
    j. Notation of dimensions established by field measurement.
    k. Relationship to adjoining construction clearly indicated.
    l. Seal and signature of professional engineer if specified.
    m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 22 by 34 inches.
3. Number of Copies: Submit two copies of each submittal. Government will return one copy.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Lot.
    e. Style.
    f. Color.
    g. Locations of use.
    h. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available. Color selections will be made only after all related color samples have been received.

    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Government will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit two sets of Samples. Government will retain one Sample set; remainder will be returned.

E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.

1. Number of Copies: Submit two copies of product schedule or list, unless otherwise indicated. Government will return one copy.

F. Schedule of Values: Comply with requirements specified in Division 01 Section "Unit Prices and Schedule of Values."

G. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.

1. Number of Copies: Submit two copies of subcontractor list, unless otherwise indicated.

2.2 INFORMATIONAL SUBMITTALS

A. Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit one copy of each submittal, unless otherwise indicated. Government will not return copies.

2. Certificates and Certifications: Provide notarized statement that includes signature of entity responsible for preparing certification, signed by officer or other individual authorized to sign documents on behalf of that entity. State that the named product conforms to the Contract requirements. Submit certificate with a certified copy of test results, or certify that such test results are on file with the manufacturer and will be furnished to Government upon request. Provide name and address of manufacturer, testing agency, and date of tests. The certificate shall set forth the means of identification which will permit field determination of the product delivered as being the product covered by the certification.
3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

D. Conformance Certificates: Prepare written certification that material complies with Contract Documents. Include evidence prior to sampling and testing.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on

evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.

S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Statement on condition of substrates and their acceptability for installation of product.
2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.

T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

2.3 DELEGATED DESIGN

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

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Government.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit two copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Government.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 GOVERNMENT'S ACTION

A. General: Government will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Government will review each submittal, make marks to indicate corrections or modifications required, and return it. Government will stamp each

submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. APPROVED.
2. APPROVED, SUBJECT TO COMPLIANCE WITH THE ATTACHED COMMENTS.
3. NOT APPROVED.

C. Informational Submittals: Government will review each submittal and will not return it, or will return it if it does not comply with requirements. Government will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

F. Written approval of submittals is indication that Contractor's submittals have been reviewed and there are no objections, except as noted.

G. Installation of material on basis of written approval of submittals shall not relieve Contractor of responsibility for incorporating material that conforms to requirements of Contract Documents.

H. Written approval of deviations shall apply only to those deviations or omissions from the requirements of Contract Documents brought to Government's attention in writing.

I. After written approval of an item, Contractor may submit substitution for approval, if approved item cannot be purchased or delivered in time to avoid delay in completion of the project.

J. Measurements: Where approved manufacturer's diagrams and shop drawings give specific measurements or rough-in dimensions for equipment, these dimensions shall take precedence over dimensions indicated on Drawings.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and -control services required by Government or authorities having jurisdiction are not limited by provisions of this Section.

C. See Divisions 02 through 31 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Government.

C. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

I. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Government for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Government for a decision before proceeding.

1.4 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

C. Permits, Licenses, and Certificates: For Government records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.5 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.6 QUALITY CONTROL

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

1. Government will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Tests and inspections not explicitly assigned to Government are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

   a. Contractor shall not employ same entity engaged by Government, unless agreed to in writing by Government.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Government and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Government and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

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

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

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

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

1.7 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Contractor will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Contractor, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Government's action on Contractor's submittals, applications, and requests, "approved" is limited to Government's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Government. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

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

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Where a conflict occurs between reference documents and project specifications, submit a request for clarification to the Government.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA)
CFR	Code of Federal Regulations
FS	Federal Specification
ICC-ES	ICC Evaluation Service, Inc.
MILSPEC	Military Specification and Standards
UFAS	Uniform Federal Accessibility Standards

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

AA	Aluminum Association, Inc. (The)
AABC	Associated Air Balance Council
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
ARI	Air-Conditioning & Refrigeration Institute
ASCE	American Society of Civil Engineers

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (The American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWS	American Welding Society
CGA	Compressed Gas Association
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute (The)
EIA	Electronic Industries Alliance
ICEA	Insulated Cable Engineers Association, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
ISO	International Organization for Standardization
LPI	Lightning Protection Institute
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NADCA	National Air Duct Cleaners Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFPA	NFPA (National Fire Protection Association)
SMACNA	Sheet Metal and Air Conditioning Contractors'

National Association

UL Underwriters Laboratories Inc.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

IAPMO International Association of Plumbing and Mechanical Officials

ICC International Code Council (Formerly: CABO - Council of American Building Officials)

ICC-ES ICC Evaluation Service, Inc.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

EPA Environmental Protection Agency

NIST National Institute of Standards and Technology

OSHA Occupational Safety & Health Administration

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary utilities, temporary field office, first aid, sanitary facilities, other support facilities, vehicular access, temporary heat, ventilation and security and protection facilities, temporary barriers and controls, and project identification.

B. See Division 01 Section "Execution Requirements" for progress cleaning requirements.

1.2 DEFINITIONS

A. Permanent Enclosure: As determined by Government, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

B. Restricted Area: An area where entry will not be allowed unless authorized by Government.

1.3 USE CHARGES

A. Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Government construction forces, Government, testing agencies, and authorities having jurisdiction.

B. Water Service: Water from Government 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. In the event of a service outage due to the construction the contractor needs to provide service as needed for construction. Service may be used from other buildings on site if feasible.

C. Electric Power Service: Electric power from Government 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. In the event of a service outage due to the construction the contractor needs to provide service as needed for construction. Service may be used from other buildings on site if feasible.

1.4 SUBMITTALS

A. First Aid Plans: Submit plans for providing medical attention for injured or disabled employees, including onsite emergency facilities and ambulance service, before start of operations.

1.5 QUALITY ASSURANCE

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

B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."

1.6 REGULATORY REQUIREMENTS

A. Comply with applicable local regulations for haul routes over public highways, roads, or bridges. Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including following:

1. Building code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, fire department, and rescue squad rules.
5. Environmental protection regulations.
6. Prevention and control of air pollution.

1.7 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Government acceptance, regardless of previously assigned responsibilities.

B. Explosives: Use will not be permitted.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Provide office for use of non-Government persons working at project site. Provide Contractor's office as separate structure from Government's office. Size, location, and construction shall be subject to Government's approval.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

C. Safety Fencing: Orange plastic fencing, 4-foot minimum height.

D. Tarpaulins: Waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of 15 or less. Provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins for temporary enclosures.

E. Water: Provide potable water approved by local health authorities.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. Toilet Units: Self-contained, single-occupant toilet units of chemical, aerated recirculation, or combustion type. Provide units properly vented and fully enclosed with glass-fiber-reinforced polyester shell or similar nonabsorbent material.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Electrical power and water are available on the site and will be provided by the Government to the Contractor. Install temporary service or connect to existing service except for data server temporary cooling system.

1. Arrange with utility company, Government, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Use of Government existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Government. At Substantial Completion, restore these facilities to condition existing before initial use.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel and for government employees (approximately 50 employees) during construction. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

D. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on

completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

E. Electric Power Service: Use of Government existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Government. No electrical materials which are part of the permanent electrical system may be used for temporary electrical installations unless approved in writing by Government. Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.

F. Maintenance of Temporary Utilities and Services: Contractor shall maintain temporary utilities and services in good operating condition until removal. Contractor shall protect from utilities and services from environmental and physical damage.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Government.

B. Parking: Use designated areas of Government existing parking areas for construction personnel. Provide additional offsite parking when site space is not adequate. Locate as approved by Government.

C. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution Requirements" for progress cleaning requirements. Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements. Do not hold materials more than seven days during normal weather or three days when temperature is expected to rise above 80 degrees F. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.

D. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

E. Safety Facilities: Provide safety showers, eyewash fountains, and similar facilities for safety and sanitation of personnel.

F. First-Aid Facilities: Make first-aid facilities and services obvious and available for providing emergency aid to personnel on the site.

3.4 STORAGE/STAGING AREAS

A. Storage/Staging Areas: Construct temporary area for trailers, equipment, and materials, located as approved by Government. Fencing of materials or equipment shall not be required at this site. Trailers, materials, or equipment shall not be placed or stored outside area unless trailers, materials, or equipment are assigned separate and distinct storage area by Government away from vicinity of construction site but within Government property boundaries.

B. Maintenance: Maintain parking and storage areas, in sound, smooth condition.

C. Repair: Promptly repair ruts, broken pavement, potholes, low areas with standing water, and other deficiencies to maintain road and parking area surfaces and drainage in original or specified condition.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

1. Construct fence, barricade, or otherwise block off immediate work area to prevent unauthorized entry.
2. Illuminate barricades and obstructions at night; keep safety lights burning from sunset to sunrise.
3. Adequately barricade and post open cuts in or adjacent to thoroughfares.
4. Cover pipes, hoses, and power lines crossing sidewalks and walkways with troughs using beveled edge boards.

B. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

C. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Government from fumes and noise.

D. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 AIR POLLUTION CONTROL

A. Responsibility: Contractor shall be responsible for damages resulting from dust originating from Contractor operations. Government may stop construction activity contributing to air pollutant levels which are excessive or in violation of Federal, State, or local laws. Expenses resulting from work stoppage will be responsibility of Contractor.

B. Requirements: Utilize such methods and devices as are reasonably available to prevent, control, and otherwise minimize atmospheric emissions or discharges of air contaminants.

1. Do not operate equipment and vehicles that show excessive emissions of exhaust gases until corrective repairs or adjustments reduce such emissions to acceptable levels.
2. Provide dust control and abatement during construction. Prevent, control, and abate dust pollution on rights-of-way provided by Government or elsewhere during performance of work. Provide labor, equipment, and materials, and use efficient methods wherever and whenever required to prevent dust nuisance or damage to persons, property, or activities, including crops, orchards, cultivated fields, wildlife habitats, dwellings and residences, agricultural activities, recreational activities, traffic, and similar conditions.

3.7 NOISE CONTROL

A. Requirements: All work performed under this contract shall be conducted in a professional manner and shall consist of safe, high quality workmanship that is not unnecessarily disruptive to the occupants of the building and adjacent areas.

3.8 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain temporary structures, facilities, and controls in good operating condition as required for safe and proper completion of Work and as directed by Government, until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Remove construction debris, waste materials, and packaging material from work site daily. Clean dirt or mud tracked onto paved or surfaced roadways. Store salvageable materials, resulting from demolition activities, within storage area. Stack stored material not in trailers, whether new or salvaged.

2. Restore areas used by Contractor for storage of equipment or material, or other use, to original or better condition. Restore area to original condition, including top soil and seeding as necessary.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. See Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.

C. See Divisions 02 through 31 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.3 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified material or product cannot be provided.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Government and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated. Provide sufficient calculations and data to justify selection of proposed item and permit comparisons.
d. Product Data, including technical data, drawings, performance information, and descriptions of products and fabrication and installation procedures. Show complete layout of system, except that which is identical to Contract Documents, unless unchanged portion must be shown to indicate clearances. Include drawings, same (or larger) scale as Contract Drawings, marked to show differences. Include detail drawings of supports for equipment and load calculations, stamped and signed by a registered professional engineer.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

2. Government Action: If necessary, Government will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Government will notify Contractor of acceptance or rejection of proposed substitution

within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Acceptance: Modification.
b. Use product specified if Government cannot make a decision on use of a proposed substitution within time allocated.

B. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Government Action: If necessary, Government will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Government will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
b. Use product specified if Government cannot make a decision on use of a comparable product request within time allocated.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

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

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

B. Delivery and Handling:

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

5. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

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

1.6 PRODUCT WARRANTIES

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

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Government.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Government.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to Divisions 02 through 27 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Government reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Government will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Government's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in

Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.

9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Government's sample. Government's decision will be final on whether a proposed product matches.

    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Government will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Government will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Government will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Government.

B. Conditions: Government will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Government will return requests without action, except to record noncompliance with these requirements:

    1. Requested substitution offers Government a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Government must assume. Government additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Government, and similar considerations.
    2. Requested substitution does not require extensive revisions to the Contract Documents.
    3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    4. Substitution request is fully documented and properly submitted.
    5. Requested substitution will not adversely affect Contractor's Construction Schedule.
    6. Requested substitution has received necessary approvals of authorities having jurisdiction.
    7. Requested substitution is compatible with other portions of the Work.
    8. Requested substitution has been coordinated with other portions of the Work.
    9. Requested substitution provides specified warranty.

2.3 COMPARABLE PRODUCTS

A. Conditions: Government will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Government will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. General installation of products.
3. Progress cleaning.
4. Starting and adjusting.
5. Protection of installed construction.
6. Correction of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Before construction, verify the location and points of connection of supply and return ductwork, electrical and structural elements.

B. Existing Utilities: The existence and location of utilities and construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of utilities and other construction affecting the Work.

1. Before construction, verify the location of points of connection of mechanical and electrical work.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Equipment: Prior to ordering equipment, verify dimensions and functions of equipment proposed for use including the electrical service requirements. Ensure equipment is compatible with structural and architectural features of Work, avoids conflicts with equipment of other crafts, and that equipment will fit in space provided.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Government. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings. If discrepancies are discovered, notify Government promptly.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Government.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than seven days during normal weather or 3 days if the temperature is expected to rise above 80 degrees F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

K. Environmental Considerations: Excavate areas of fuel or oil spills occurring during Work to depth of 12 inches beyond contaminated material and remove from the work location. Observe prescribed measures to prevent water pollution to nearby water resources.

3.6 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

C. Right-of-Way: Carefully maintain right-of-way over existing utility lines and other encountered lines in proper alignment. Should Contractor find that grades of new utility lines intersect existing utility lines, stop laying of new lines until new grades are established or adjusted by Government.

3.8 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Do not initiate repair of damage to new or existing construction and equipment resulting from construction procedures, prior to notification of Government. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Utility Lines: Repair damages to new or existing active utility above or below ground, whether indicated on Drawings or not, and immediately report such damage to Government. Pay for repair costs for damages because of Contractor's negligence.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017320 - 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. Division 01 Section "Summary" for restrictions on use of the premises, Government-occupancy requirements.

1.3 DEFINITIONS

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

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

C. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Government for storage.

1.4 MATERIALS OWNERSHIP

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

1.5 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Government'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. Coordination of Government's continuing occupancy of portions of existing building and of Government's partial occupancy of completed Work.

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

1.6 FIELD CONDITIONS

A. Government will allow the building to be unoccupied for a period specified by specification 011000 to facilitate demolition and construction.

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

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

D. Hazardous Materials: It is expected that hazardous materials will be encountered in the Work, reference hazardous material reports, provided by the government, for extents and types of materials. Reference abatement drawing and specification 028214 for further information.

1. If any other suspected hazardous materials are encountered, that are not stated in the report or drawings, do not disturb; immediately notify Government. These hazardous materials will be removed by Government under a separate contract.

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

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

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

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

1.8 COORDINATION

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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

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

1. Arrange to shut off utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Equipment to Be Removed: Disconnect and cap services and remove equipment.

c. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean and store equipment; when appropriate, reinstall, reconnect and make equipment operational.
d. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Government.

3.3 PROTECTION

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

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."

B. 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. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
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. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
8. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management."

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. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Government, 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 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Division 01 Section "Construction Waste Management."

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.

B. Burning: Do not burn demolished materials.

3.6 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.

3.7 SELECTIVE DEMOLITION SCHEDULE

A. Remove: Items indicated on the drawings to be removed, or as required to accommodate new construction.

END OF SECTION 017320

SECTION 017329 - CUTTING AND PATCHING

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. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Divisions 02 through 31 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety except as indicated on the drawings. Operating elements include the following:

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-suppression systems.
4. Mechanical systems piping and ducts.
5. Control systems.
6. Communication systems.
7. Conveying systems.
8. Electrical wiring systems.
9. Operating systems of special construction.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Government's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas. Coordinate any interruption of service with the Government prior to work.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

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

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE GOALS

A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling of 50 percent by weight of total waste generated by the Work.

B. Salvage/Recycle Goals: Government goal is to salvage and recycle as much nonhazardous demolition and construction waste as possible.

1.4 SUBMITTALS

A. Waste Management Plan: Submit one electronic copy of plan within 7 days of date established for the Notice to Proceed.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit one electronic copy of report. Include separate reports for demolition and construction waste. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit one electronic copy of calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification and waste reduction work plan. Include separate sections in plan for demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.

2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Government. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Protect items from damage during transport and storage.

4. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Government Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Government.
4. Transport items to Government storage area on-site.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the following:

1. Recycle Boise
2. Western Recycling
3. Pacific Steel and Recycling

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical. If space is limited, co-mingled recycling is acceptable.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
2. Stockpile processed materials on-site. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Government property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

B. Metals: Separate metals by type.

1. Remove and dispose of bolts, nuts, washers, and other rough hardware.

C. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

1. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.

D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

E. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

F. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

G. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Government property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Warranties.
3. Final cleaning.

B. See Division 01 Section "Project Record Documents" for submitting Record Drawings and Record Product Data.

C. See Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

D. See Divisions 02 through 31 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Prepare and submit Project Record Documents, operation and maintenance manuals, and similar final record information.
3. Deliver tools, spare parts, extra materials, and similar items to location designated by Government. Label with manufacturer's name and model number where applicable.
4. Complete startup testing of systems.
5. Submit test/adjust/balance records.
6. Terminate and remove temporary facilities from Project site, along with construction tools, and similar elements.
7. Complete final cleaning requirements, including touchup painting.
8. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Government will either proceed with inspection or notify Contractor of unfulfilled requirements. Government will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Government, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit copy of Government's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Government. The copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
2. Instruct Government personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Government will either proceed with inspection or notify Contractor of unfulfilled requirements. Require superintendent, mechanical, and electrical subcontractors to be present during final inspection. Government will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

1.5 WARRANTIES

A. Materials and equipment furnished under this Contract shall be covered by the most-favorable commercial warranties Contractor provides to any customer for such materials or equipment. Rights or remedies provided shall be in addition to, and not limit, any rights afforded to Government by any other clause of this Contract. With respect to all warranties, expressed or implied, from manufacturers or suppliers for materials or equipment furnished under the Contract, Contractor shall:

1. Obtain warranties that would be given in normal, commercial practices.
2. Require warranties to be executed, in writing, for the benefit of the Government.

3. Submit warranties to Government, after the final inspection.

B. Submittal Time: Submit written warranties on request of Government for designated portions of the Work where commencement of warranties other than date of Final Completion is indicated.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
g. Sweep concrete floors broom clean in unoccupied spaces.
h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
i. Remove labels that are not permanent.
j. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

    1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

k. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
l. Replace parts subject to unusual operating conditions.
m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
n. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
o. Leave Project clean and ready for occupancy.

C. Disposal of Debris: Items or debris not designated as salvage by Government shall become property of Contractor. Disposal of materials off site in a legal manner and payment of required fees shall be Contractor's responsibility. Sale of material onsite will not be allowed. When hazardous materials are encountered during demolition operations, comply with applicable federal, state, and local regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.

D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Government property. Do not discharge volatile, harmful, or dangerous materials into drainage systems.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation manuals for systems, subsystems, and equipment.
2. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.

B. See Divisions 02 through 31 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 SUBMITTALS

A. Manual: Submit one copy of each manual in final form at least 15 days before final inspection. Government will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Government's comments. Submit 2 copies of each corrected manual within 15 days of receipt of Government's comments.

PART 2 - PRODUCTS

2.1 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Government.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each Section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the Section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
5. PDF Electronic file: Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable by Government.

2.2 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.

B. Descriptions: Include the following:

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

C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

2.3 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in project manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

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

D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.

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

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

2.4 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment.

D. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

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

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

C. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project Record Documents as part of operation and maintenance manuals.

E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

1. Record Drawings.
2. Record Product Data.

B. See Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.

C. See Divisions 02 through 31 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up Record Prints.

B. Record Product Data: Submit one copy of each Product Data submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain complete set of full-sized blue- or black-line white prints, as furnished by Government, of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.

3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Government.
e. Name of Contractor.

2.2 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Modifications and Record Drawings where applicable.

2.3 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and

in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Government's reference during normal working hours.

C. Submit record drawings to Government for review prior to the final inspection. Should the final inspection reveal changes in the project not so noted on the record drawings, the Contractor shall record these changes on the record drawings within 5 working days of final inspection and submit the completed record drawings to the Government.

D. Installation Changes: Maintain records, by contractor of actual installations where at variance with work shown, where changed, or where not otherwise located by dimension, elevation or other reference on Drawings. Record actual locations and elevations of equipment and components (such as pipe, conduits and ducts) occurring within concealed areas by actual dimensions referenced from readily accessible and permanent building lines or monuments.

3.2 POSTED INSTRUCTIONS

A. Mount posted instructions prior to final inspection.

B. Location: Mount typed operating instructions and diagrams in frame under 1/8-inch clear plastic near equipment, prior to providing operation training to selected Government employees.

C. Content: Posted operating instructions shall consist of simplified consolidated equipment, control, and power diagrams graphically representing entire system, including concise written instructions on how to start and stop systems, conditions to be observed and adjustments to be made by operators. Include control diagrams, operating instructions, electrical controls, and interlocks.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Government's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.2 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.3 COORDINATION

A. Coordinate instruction schedule with Government's operations. Adjust schedule as required to minimize disrupting Government's operations and to ensure availability of Government's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

1.4 INSTRUCTION PROGRAM

A. Training shall be conducted by a manufacturer’s qualified representative and be provided for up to 10 NIFC representatives for (4) four hours at the job site. Operation and Maintenance Instruction Book shall be provided.

1.5 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.6 INSTRUCTION

A. Engage qualified instructors to instruct Government's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Government with at least seven days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Cleanup: Collect used and leftover educational materials and give to Government. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 024200 – REMOVAL AND SALVAGE OF CONSTRUCTION MATERIALS

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. Procedures for reclamation of carpet waste.

SUBMITTALS

B. Proposed packing and transportation measures.

C. Reclamation agency records indicating receipt and disposition of post-consumer products.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing regulations. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.4 PROJECT CONDITIONS

A. Environmental Requirements: Obtain approval of Government before performing operations which generate contaminants.

PART 2 - PRODUCTS

2.1 Engineered Floors

Manufacturer: J+J FLOORING Phone 801.866.3670
For Questions Please Contact: Cheryl Davenport or Brett Bennett
E-mail: cheryl.davenport@enginerredfloors.com or brett.bennett@jjflooring.com

A. J+J Reclamation Program

PART 3 - EXECUTION

3.1 EXAMINATION

A. All material must be dry and free of any debris. No asbestos or hazardous material will be accepted.

3.2 PREPARATION

A. After initial approval is received sort material by product type (if applicable). Customer / Contractor is responsible for proper preparation of the material.

B. Stack the product(s) on pallets (4'x4' or smaller). We recommend alternating the direction of material every 2" in height and not exceeding 48" to ensure a safely stacked pile. Stack product so that it allows for side-by-side loading on our trailers.

C. Secure the pallets by shrink wrapping and strapping. We recommend a minimum of two straps, one on each side using rope or twine.

D. Each pallet or gaylord box should be marked with the following:
   1. Project Name
   2. Address
   3. Project Number (if applicable)
   4. Take-Back Request # should be clearly marked on all pallets / boxes.

3.3 PROCESS

Upon completion of the preparation of the carpet waste please complete the following:

A. Take-Back Request Form (provided by the ReStart Team).

B. Your ReStart representative will complete the Take-Back Request Form and assign a return number.
   a. This number should be labeled on each pallet / gaylord box.
   b. Copy the completed form and keep a copy for your records and for the trucking company.

3.4 SHIPMENT OF PRODUCT

A. Confirm all pallets / gaylord boxes are marked with Return Number.

B. Confirm material is secured for shipping.

C. Your ReStart representative will send over a bill of lading with trucking information including pick up day and time. Please make sure trucking company receives a copy of the Take-Back Request Form along with a copy of the completed Bill of Lading. Please make sure truck is loaded properly to maximize weight and to prevent pallets from falling over during shipping.

Any pallets that are not properly secured and fall over during shipping could result in a $100 per pallet penalty.

END OF SECTION 024200

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Fire-retardant-treated lumber.
3. Dimension lumber framing.
4. Miscellaneous lumber.
5. Plywood backing panels.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 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 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.
2. 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 in accordance with ASTM D5664.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. 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.

1.5 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
4. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 15 percent.
2. Dimension Lumber: 15 percent unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED LUMBER

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.

2.3 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.

B. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

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

2.5 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 ICC-ES AC308 as appropriate for the substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

D. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

G. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

K. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

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

END OF SECTION

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Glass-fiber blanket insulation.
2. Mineral-wool blanket insulation.
3. Mineral-wool board insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Glass-fiber blanket insulation.
2. Mineral-wool blanket insulation.
3. Mineral-wool board insulation.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Research 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 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced - Wall Batt Insulation: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

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. CertainTeed Corporation.
   b. CertainTeed Insulation.
   c. Johns Manville; a Berkshire Hathaway company.
   d. Knauf Insulation.
   e. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.2 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced Wall Batt Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

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. Johns Manville; a Berkshire Hathaway company.
   b. Rockwool International.
   c. Thermafiber, Inc.; an Owens Corning company.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.

4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.3 MINERAL-WOOL BOARD INSULATION

A. Mineral-Wool Board Insulation, Type III, Faced Wall Rigid Insulation: ASTM C612, Type III; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder.

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. Johns Manville; a Berkshire Hathaway company.
   b. Rockwool International.
   c. SPI, LLC dba, SPI Ó Specialty Products & Insulation.
   d. Thermafiber, Inc.; an Owens Corning company.

2. Nominal Density: 8 lb/cu. ft. (128 kg/cu. m).
3. Flame-Spread Index: Not more than 15 when tested in accordance with ASTM E84.
4. Smoke-Developed Index: Not more than zero when tested in accordance with ASTM E84.
5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.4 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches (100 mm) from each corner of board insulation, at center of board, and as recommended by manufacturer.

1. Fit courses of insulation between masonry wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.7 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass.
2. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
3. Install insulation to fit snugly without bowing.

3.8 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Butyl joint sealants.
6. Latex joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silane-modified polymer joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Manufacturers' special warranties.

B. Installer's special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

1.6 FIELD CONDITIONS

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

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 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 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Government from manufacturer's full range.

2.3 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

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

a. Adfast Corp.
b. GE Construction Sealants; Momentive Performance Materials Inc.
c. Pecora Corporation.
d. Sika Corporation.
e. The Dow Chemical Company.

2.4 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

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

a. Adfast Corp.

b. GE Construction Sealants; Momentive Performance Materials Inc.
c. Pecora Corporation.
d. Sika Corporation.
e. The Dow Chemical Company.
f. Tremco Incorporated.

2.5 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

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

a. Adfast Corp.
b. Bostik, Inc.
c. Everkem Diversified Products, Inc.
d. Master Builders Solutions.
e. Pecora Corporation.
f. Permathane; ITW Polymer Sealants North America.
g. Polymeric Systems, Inc.
h. Sherwin-Williams Company (The).
i. Sika Corporation.
j. Tower Sealants, Inc.
k. Tremco Incorporated.

B. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 50, Uses T and NT.

2.6 MILDEW-RESISTANT JOINT SEALANTS

A. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Adfast Corp.
b. GE Construction Sealants; Momentive Performance Materials Inc.
c. Pecora Corporation.
d. Soudal USA.
e. The Dow Chemical Company.

f. Tremco Incorporated.

2.7 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

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. Bostik, Inc.
b. Everkem Diversified Products, Inc.
c. Pecora Corporation.

2.8 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Adfast Corp.
b. Everkem Diversified Products, Inc.
c. Franklin International.
d. Pecora Corporation.
e. Sherwin-Williams Company (The).
f. Tremco Incorporated.

2.9 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

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

a. Adfast Corp.
b. Alcot Plastics Ltd.
c. Construction Foam Products; a division of Nomaco, Inc.
d. Master Builders Solutions.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.10 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
4. Provide flush joint profile at locations indicated on Drawings in accordance with Figure 8B in ASTM C1193.
5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings in accordance with Figure 8C in ASTM C1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

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

3.5 PROTECTION

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

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

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

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

C. 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.
9. Details of moldings, removable stops, and glazing.

D. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.

E. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly fire-rated borrowed-lite assembly and thermally rated door assemblies for tests performed by a qualified testing agency indicating compliance with performance requirements.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 DELIVERY, STORAGE, AND HANDLING

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

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

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

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. (2.27 W/K x sq. m) when tested in accordance with ASTM C1363 or ASTM E1423.

2.2 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. .

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule on Drawings.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
   d. Edge Construction: Model 1, Full Flush.
   e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
   f. Core: Manufacturer's standard.
   g. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated doors.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Construction: Knocked down.

3. Exposed Finish: Prime.

2.3 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. .

1. Doors:

a. Type: As indicated in the Door and Frame Schedule on Drawings.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
d. Edge Construction: Model 1, Full Flush.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Polyisocyanurate.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
b. Construction: Knocked down.

3. Exposed Finish: Prime.

2.4 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).

B. Construction: Knocked down.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.6 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. 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.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

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

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
3. Smoke-Control Doors: Install doors in accordance with NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.

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

END OF SECTION

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Light frames and louvers.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.
2. Section 099300 "Staining and Transparent Finishing" for field finishing doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Solid-core seven-ply flush wood veneer-faced doors and transom panels for transparent finish.
3. Light frames and louvers.

B. Product Data Submittals: For each product, including the following:

1. Door edge construction
2. Door louvers.
3. Door frame construction.
4. Factory-machining criteria.
5. Factory-finishing specifications.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.

3. Details of frame for each frame type, including dimensions and profile.
4. 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.

D. Samples for Initial Selection: For plastic-laminate door faces.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 DELIVERY, STORAGE, AND HANDLING

A. 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 top and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Delamination of veneer.
    b. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
    c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.

1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

B. Adhesives: Do not use adhesives that contain urea formaldehyde.

C. Composite Wood Products: Products shall be made without urea formaldehyde.

2.2 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS AND TRANSOM PANELS FOR TRANSPARENT FINISH

A. Interior Doors, Solid-Core Five-Ply Veneer-Faced :

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. Lynden Door, Inc.
    b. Masonite Architectural.
    c. VT Industries, Inc.
    d. Wilsonart LLC.

2. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty.

3. ANSI/WDMA I.S. 1A Quality Grade: Custom.
4. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.

    a. Species: Select white maple.

b. Cut: Plain sliced (flat sliced).

5. Core for Non-Fire-Rated Doors:

a. ANSI A208.1, Grade LD-1 particleboard.

1) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087111 "Door Hardware (Descriptive Specification."

6. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.3 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads.

2.4 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Transom and Side Panels:

1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

3. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails.
4. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.5 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. Factory finish doors.

C. Transparent Finish:

1. ANSI/WDMA I.S. 1A Grade: Custom.

2. Staining: As selected by Contracting Officer from manufacturer's full range.
3. 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 087111 "Door Hardware (Descriptive Specification)."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.

1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).
2. Anchor frames to anchors or blocking built in or directly attached to substrates.

    a. Secure with countersunk, concealed fasteners and blind nailing.
    b. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.

        1) For factory-finished items, use filler matching finish of items being installed.
3. Install smoke- and draft-control doors in accordance with NFPA 105.

D. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
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, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.

5. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches (150 by 150 mm) in size.

C. Product Schedule: For access doors and frames.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges :

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. ACUDOR Products, Inc.
b. Babcock-Davis.
c. Cendrex Inc.
d. Lane-Aire Manufacturing Corp.
e. Metropolitan Door Industries Corp.
f. Milcor; a division of Hart & Cooley, Inc.
g. Nystrom.

2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Optional Features: Gasketing, Piano hinges.
4. Locations: Wall and ceiling.
5. Door Size: As Indicated on Drawings.
6. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.
7. Frame Material: Same material and thickness as door.
8. Latch and Lock: Cam latch, key operated.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Frame Anchors: Same material as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.

1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.

E. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.
3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087111 "Door Hardware (Descriptive Specification)."

F. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

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

3.3 ADJUSTING

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

END OF SECTION

SECTION 087111 - DOOR HARDWARE (DESCRIPTIVE SPECIFICATION)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hinges.
2. Self-closing hinges and pivots.
3. Continuous, gear-type hinges.
4. Concealed hinges.
5. Bored locks.
6. Electromechanical locks.
7. Exit devices and auxiliary items.
8. Lock cylinders.
9. Operating trim.
10. Surface closers.
11. Wall- and floor-mounted stops.
12. Door gasketing.
13. Thresholds.
14. Metal protective trim units.
15. Auxiliary door hardware.
16. Auxiliary electrified door hardware.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.
2. Section 083113 "Access Doors and Frames" for access door hardware, except cylinders.

1.2 COORDINATION

A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.

1. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Government's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field-verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Hinges.
2. Bored locks.
3. Electromechanical locks.
4. Exit devices and auxiliary items.
5. Lock cylinders.
6. Operating trim.
7. Surface closers.
8. Wall- and floor-mounted stops.
9. Door gasketing.
10. Thresholds.
11. Metal protective trim units.
12. Auxiliary door hardware.
13. Auxiliary electrified door hardware.
14. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For electrified door hardware.

1. Include diagrams for power, signal, and control wiring.
2. Include details of interface of electrified door hardware and building safety and security systems.

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. 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. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
    e. Fastenings and other installation information.
    f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
    g. Mounting locations for door hardware.
    h. List of related door devices specified in other Sections for each door and frame.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of electrified door hardware.

1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware 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, Contracting Officer, and Government about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lockup 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.

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. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
   b. Exit Devices: Two years from date of Substantial Completion.
   c. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested in accordance with UL 1784 and installed in compliance with NFPA 105.

1. Air-Leakage Rate: Maximum air leakage of 0.3 cfm per sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3 inch wg (75 Pa) of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:

   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
   b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
   c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 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. Hinges: ANSI/BHMA A156.1.

B. Antifriction-Bearing Hinges:

1. Mounting: Full mortise (butts).

2. Bearing Material: Manufacturer's standard antifriction bearing.
3. Base and Pin Metal:

    a. Exterior Hinges: Stainless steel with stainless steel pin.
    b. Interior Hinges: Stainless steel with stainless steel pin.
    c. Hinges for Fire-Rated Assemblies: Stainless steel with stainless steel pin.

4. Pins: Nonrising loose unless otherwise indicated.

    a. Outswinging Exterior Doors: Nonremovable.
    b. Outswinging Corridor Doors with Locks: Nonremovable.

5. Tips: Flat button.
6. Corners: Square.

C. Electrified Antifriction-Bearing Hinges: Full-mortise mounting.

1. Bearing Material: Manufacturer's standard antifriction bearing.
2. Grade 1 (heavy weight).
3. Base and Pin Metal:

    a. Exterior Hinges: Stainless steel with stainless steel pin.
    b. Interior Hinges: Stainless steel with stainless steel pin.
    c. Hinges for Fire-Rated Assemblies: Stainless steel with stainless steel pin.

4. Pins: Nonrising loose unless otherwise indicated.

    a. Outswinging Exterior Doors: Nonremovable.
    b. Outswinging Corridor Doors with Locks: Nonremovable.

5. Tips: Flat button.
6. Corners: Square.
7. Electric Feature: Concealed electric through wires.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.

C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:

1. Description: As indicated on Drawings.

2. Levers: Cast.

   a. <Insert model number and description>.

3. Escutcheons (Roses): Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

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.

F. Bored Locks: ANSI/BHMA A156.2, Grade 1, Series 4000.

   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. BEST Access Solutions, Inc.; dormakaba USA Inc.
      b. dormakaba USA Inc.
      c. Lawrence Hardware Inc.
      d. Marks USA; Napco Security Technologies, Inc.
      e. PAMEX Inc.
      f. PDQ Industries, Inc.
      g. SOSS Door Hardware; Universal Industrial Products, Inc.
      h. STANLEY; dormakaba USA, Inc.

2.5 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: ANSI/BHMA A156.25, Grade 2; motor or solenoid driven; with strike that suits frame.

   1. Provide Best Access Systems, 45HW-7-DEU-15-H-626-XXX-RQE with Temperature Control Module, or equal.
   2. Type: Mortise deadlocking latchbolt.

2.6 EXIT DEVICES AND AUXILIARY ITEMS

A. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.

B. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing in accordance with UL 305 and NFPA 252.

C. Rim Exit Devices: Grade 1.

1. Actuating Bar: Narrow-stile push pad.
2. Material: Aluminum.
3. Electrified Features:

a. Electric locking and unlocking.
b. Fail secure electrically unlocked lever. Exit device latch is always engaged. Presenting an active credential unlocks the lever trim and relocks automatically.
c. Request to Exit Signal - Rail Monitoring.

2.7 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Provide Stanley-Best Access System; 1C Core, 7 Pin.

B. Standard Lock Cylinders: ANSI/BHMA A156.5, Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable.
2. Number of Pins: Seven.

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.

2.8 KEYING

A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock.

1. Existing System:

a. Key locks to Government's existing system.

2.9 OPERATING TRIM

A. Operating Trim: ANSI/BHMA A156.6; stainless steel unless otherwise indicated.

B. Flat Push Plates: With square corners and beveled edges; secured with exposed screws.

1. Thickness: 0.050 inch (1.3 mm).
2. Size: 4 inches wide by 16 inches high (102 mm wide by 406 mm high).

C. Straight Door Pulls:

1. Type: 3/4-inch (19-mm) constant-diameter pull.
2. Mounting: Surface applied with concealed fasteners.
3. Minimum Clearance: 1-1/2 inches (38 mm) from face of door.
4. Overall Length: 9 inches (229 mm).

2.10 SURFACE CLOSERS

A. Surface Closers: ANSI/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.

B. Surface Closer with Cover: Grade 1; modern type with mechanism enclosed in cover.

1. Mounting: Hinge side.
2. Type: Regular arm Hold-open.
3. Backcheck: Adjustable, effective between 60 and 85 degrees of door opening.
4. Cover Material: Aluminum.
5. Closing Power Adjustment: At least 35 percent more than minimum tested value.

2.11 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: ANSI/BHMA A156.16; base metal.

B. Dome-Type Floor Stop: Grade 1; with minimum 1-inch- (25-mm-) high bumper for doors without threshold and 1-3/8-inch- (35-mm-) high bumper for doors with threshold.

1. Provide with extruded-aluminum riser for carpet installations.

C. Chain Door Stops: Grade 2; welded chain, each end attached to compression springs, both covered with protective sleeve; for surface-screw application.

D. Wall Bumpers: Grade 1; with rubber bumper; 2-1/2-inch (64-mm) diameter, minimum 3/4-inch (19-mm) projection from wall; with backplate for concealed fastener installation.

1. Bumper Configuration: Concave.

2.12 DOOR GASKETING

A. Door Gasketing: ANSI/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 in accordance with ASTM E283/E283M with tested pressure differential of 0.3 inch wg (75 Pa), as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
3. Gasketing on Double Doors: 0.50 cfm per ft. (0.000774 cu. m/s per m) of door opening.

C. Adhesive-Backed Perimeter Gasketing: Neoprene bulb gasket material applied to frame rabbet with self-adhesive.

D. Door Sweeps: Neoprene gasket material held in place by flat housing or flange; surface mounted to face of door with screws.

1. Housing or Flange Material: Aluminum.

2.13 THRESHOLDS

A. Thresholds: ANSI/BHMA A156.21; fabricated to full width of opening indicated.

B. Compressing-Top Thresholds: Metal member with compressible vinyl seal on top of threshold that seals against bottom of door; and base metal of aluminum.

C. Saddle Thresholds:

1. Type: Fluted top, barrier free.
2. Base Metal: Aluminum.

2.14 METAL PROTECTIVE TRIM UNITS

A. Kick Plates: 12 inches (305 mm) high by door width with allowance for frame stops.

2.15 AUXILIARY DOOR HARDWARE

A. Silencers for Metal Door Frames: Grade 1; neoprene or rubber; minimum diameter 1/2 inch (13 mm); fabricated for drilled-in application to frame.

2.16 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware: ANSI/BHMA A156.35.

B. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; listed and labeled for use with fire-alarm systems.

C. Monitor Strikes: Cast strike with toggle.

D. Door Position Switches: Magnetically operated reed switch designed for concealed mounting.

E. Door and Frame Transfer Devices: Steel housing for mortise in hinge stile of door, with flexible tube for wiring bundle; accommodating doors that swing open to 120 degrees.

2.17 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 Contracting Officer.

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 ANSI/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; however, 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. Wood or Machine Screws: For the following:

1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and 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.

2.18 FINISHES

A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.

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, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

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.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

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.
2. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

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 in accordance with 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 (760 mm) 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. Government to provide and install permanent cores.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

F. 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.

G. 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.

H. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 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.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.5 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.

3.6 MAINTENANCE SERVICE

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

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Glazing sealants.
4. Miscellaneous glazing materials.

1.2 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 in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.

1. Tinted glass.
2. Insulating glass.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturers of fabricated glass units.

B. Product Certificates: For glass.

C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with 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.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.10 WARRANTY

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

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

B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

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

C. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

1. Design Wind Pressures: As indicated on Drawings.

   a. Wind Design Data: As indicated on Drawings.

2. Design Snow Loads: As indicated on Drawings.
3. Probability of Breakage for Sloped Glazing: For glass sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
5. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
4. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
5. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

F. Acoustic Performance:

1. Exterior Glazing: 28 OITC.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

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. AGC Glass Company North America, Inc.

b. Guardian Glass; SunGuard.
c. Pilkington North America.
d. Vitro Architectural Glass.

B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

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. Guardian Glass; SunGuard.
b. Pilkington North America.
c. Viracon, Inc.
d. Vitro Architectural Glass.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Government from manufacturer's full range of industry colors.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by 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 in writing by sealant or glass manufacturer.

D. Spacers:

1. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. Type recommended in writing by sealant or glass manufacturer.

2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

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

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

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

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 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 in writing 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 in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.5 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 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 contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.7 MONOLITHIC GLASS SCHEDULE

A. Clear Glass Type : Annealed Fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

3.8 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Tinted Insulating Glass Type :

1. Basis-of-Design Product: Solarban 70 on Solargray by Vitro Architectural Glass.
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Tinted fully tempered float glass.
5. Tint Color: Gray.
6. Interspace Content: Argon.
7. Indoor Lite: Clear annealed fully tempered float glass.
8. Low-E Coating: Pyrolytic or sputtered on second or third surface.
9. Winter Nighttime U-Factor: 0.24 maximum.
10. Summer Daytime U-Factor: 0.24 maximum.
11. Visible Light Transmittance: 30 percent minimum.
12. SGHC: 0.30 maximum.
13. Safety glazing required.

END OF SECTION

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing systems.
2. Suspension systems.
3. Grid suspension systems.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Framing systems.
2. Suspension systems.
3. Grid suspension systems.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.

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

C. Horizontal Deflection: For wall assemblies, limited to 1/360 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa).

D. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

E. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. (239 Pa) minimum as required by the IBC.

2.2 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Framing Members, General: Comply with AISI S220 for conditions indicated.

1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated
2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.

    a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

C. Studs and Track: AISI S220.

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. CEMCO; California Expanded Metal Products Co.
    b. ClarkDietrich.
    c. Jaimes Industries.

d. MRI Steel Framing, LLC.
e. SCAFCO Steel Stud Company.
f. Steel Construction Systems.

2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
3. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Provide the following:

1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

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

1) CEMCO; California Expanded Metal Products Co.
2) ClarkDietrich.
3) SCAFCO Steel Stud Company.
4) Steel Construction Systems.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).

F. Hat-Shaped, Rigid Furring Channels:

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. ClarkDietrich.
b. Jaimes Industries.
c. MRI Steel Framing, LLC.
d. SCAFCO Steel Stud Company.
e. Steel Construction Systems.
2. Depth: As indicated on Drawings.

G. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

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. ClarkDietrich.

b. MRI Steel Framing, LLC.
c. SCAFCO Steel Stud Company.
d. Steel Construction Systems.

2. Configuration: Asymmetrical.

H. Z-Shaped Furring: With slotted, thermally improved web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 3/4 inch (19 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 AC193 AC58 orAC308 as appropriate for the substrate.

a. Uses: Securing hangers to structure.
b. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor, or adhesive anchor.
c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 2-1/2 inches (64 mm).

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Tracks:

a. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).
b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: 7/8 inch (22 mm) deep.

a. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).

2.4 GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

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

a. Armstrong Ceiling & Wall Solutions.
b. Certainteed; SAINT-GOBAIN.
c. Rockfon; ROCKWOOL International.
d. USG Corporation.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF FRAMING SYSTEMS

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLATION OF SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 24 inches (610 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

3.6 INSTALLATION OF GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

END OF SECTION

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum board, Type X.
2. Mold-resistant gypsum board.
3. Glass-mat, water-resistant backing board.
4. Interior trim.
5. Joint treatment materials.
6. Laminating adhesive.
7. Sound-attenuation blankets.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.3 DELIVERY, STORAGE AND HANDLING

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

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

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

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with 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 in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.3 GYPSUM BOARD, GENERAL

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

2.4 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

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

a. American Gypsum.
b. Certainteed; SAINT-GOBAIN.
c. Georgia-Pacific Gypsum LLC.

d. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered.

B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

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; SAINT-GOBAIN.
c. Georgia-Pacific Gypsum LLC.

d. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.5 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

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. Certainteed; SAINT-GOBAIN.
b. Georgia-Pacific Gypsum LLC.
c. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

a. Cornerbead.
b. L-Bead: L-shaped; exposed long flange receives joint compound.

c. Expansion (control) joint.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

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.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.8 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

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. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

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

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Vertical surfaces unless otherwise indicated.
2. Mold-Resistant Type: As indicated on Drawings.

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 horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

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

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints in accordance with ASTM C840 and in specific locations approved by Government for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. L-Bead: Use where indicated on Drawings.

3.6 FINISHING OF GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, 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 in accordance with ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

3.7 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

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Sustainable Design Submittals:

1. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and pre-consumer recycled content.

C. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

D. Samples for Initial Selection: For components with factory-applied finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

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. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Ceiling System: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class C in accordance with ASTM E1264.
2. Smoke-Developed Index: 50 or less.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS "AC1"

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. Armstrong Ceiling & Wall Solutions. Basis of Design: Fine Fissured Second Look - 1761
2. Certainteed; SAINT-GOBAIN.
3. Rockfon; ROCKWOOL International.

B. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Classification: Provide panels as follows:

1. Type and Form, Type III: Mineral base with painted finish; Form 2, water felted.

D. Color: White.

E. Light Reflectance (LR): Not less than 0.82.

F. Ceiling Attenuation Class (CAC): Not less than 35.

G. Noise Reduction Coefficient (NRC): Not less than 0.55.

H. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.

I. Thickness: 3/4 inch (19 mm).

J. Modular Size: 24 by 48 inches (610 by 1220 mm).

K. Recycled Content: Not less than 34%

2.4 METAL SUSPENSION SYSTEM

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. Armstrong Ceiling & Wall Solutions. Basis of Design: Prelude XL 15/16”
2. Certainteed; SAINT-GOBAIN.
3. Rockfon; ROCKWOOL International.
4. USG Corporation.

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.

C. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

D. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; pre-painted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Finish: Painted white.

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing in accordance with ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Post installed bonded anchors.
b. Corrosion Protection, Carbon Steel: Components zinc plated in accordance with ASTM B633, Class SC 1 (mild) service condition.
c. Corrosion Protection, Stainless Steel: Components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.
d. Corrosion Protection, Nickel-Copper Alloy: Components fabricated from nickel-copper-alloy rods complying with ASTM B164 for UNS No. N04400 alloy.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-) diameter wire.

C. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Angle Hangers: Angles with legs not less than 7/8-inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

E. Hold-Down Clips: Manufacturer's standard hold-down.

2.6 METAL EDGE MOLDINGS AND TRIM

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. Armstrong Ceiling & Wall Solutions.
2. Certainteed; SAINT-GOBAIN.
3. Flannery, Inc.
4. Fry Reglet Corporation.
5. Gordon Inc.
6. Rockfon; ROCKWOOL International.
7. USG Corporation.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counters playing, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

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 post installed anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attaches moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels as follows:

a. As indicated on reflected ceiling plans.
b. Install panels with pattern running in one direction parallel to long axis of space.
c. Install panels in a basket-weave pattern.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install clips in areas indicated; space in accordance with panel manufacturer's written instructions unless otherwise indicated.

7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
8. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Thermoplastic-rubber base.
2. Rubber molding accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.

3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Johnsonite; A Tarkett Company.
2. Roppe Corporation, USA.
3. Or approved equal, to be approved by Contracting Officer Representative.

B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).

1. Group: I (solid, homogeneous).
2. Style and Location:

a. Style B, Cove: .

C. Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: NIFC Standard Johnsonite 110 Brown.

2.2 RUBBER MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Roppe Corporation, USA.
2. Johnsonite: A Tarkett Company.
3. Or equal, to be approved by Contracting Officer Representative.

B. Description: Rubber transition strips.

C. Colors and Patterns: As selected by Contracting Officer Representative from full range of industry 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 resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Metal Edge Strips: Extruded aluminum with mill finish, nominal 2 inches (50.8 mm) wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

    a. Miter corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.
3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 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 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz floor tile

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Environmental Product Declaration: For each product.
3. Environmental Product Declaration: For each product.
4. Third-Party Certifications: For each product.
5. Third-Party Certified Life Cycle Assessment: For each product.

C. Samples: Full-size units of each color, texture, and pattern of floor tile required.

D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM 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 QUARTZ FLOOR TILE RF1

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

1. Altro Group
2. Johnsonite; A Tarkett Company;
3. Rikett America
4. Kahrs UpoFloor; Basis of Design
5. Or approved USA made alternate, as approved by Contracting Officer Representative.

B. Tile Standard: ASTM F 1066.

1. Class: Class II, Through-Pattern.
2. ISO 10595 Type: II.

C. Thickness: 8 MM.

D. Size: 12 by 24 inches.

E. Colors and Patterns: Basis of Design: Subject to compliance with requirements, provide Kahrs UpoFloor Lines Quartz Tile, color 8224 Hypersthene Ash.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM 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. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. 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.

F. 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.
2. Ashlar installation pattern.

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. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Modular carpet tile.

B. Related Requirements:

1. Section 096519 "Resilient Tile Flooring" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. 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. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.9 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.

1.10 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

    a. More than 10 percent edge raveling, snags, and runs.
    b. Dimensional instability.
    c. Excess static discharge.
    d. Loss of tuft-bind strength.
    e. Loss of face fiber.
    f. Delamination.
    g. .

3. Warranty Period: 15 years from date of Substantial Completion.

B. All warranties must be issued by the manufacturer as standard published warranties on all types of flooring modules within this document. Second source warranties that involve parties other than the textile composite flooring manufacturer are unacceptable. If the product fails to perform as warranted when installed according to manufacturer installation instructions and maintained according to manufacturer's maintenance instructions, the affected area will be repaired or replaced at the expense of the manufacturer.

1. Lifetime product performance. Will not delaminate along seams or lose more than five (5%) percent by weight of fiber during its useful life.
2. Lifetime static propensity, meaning built-in protection below 3.0 kv as tested under AATCC-134.
3. Lifetime Stain Removal
4. Lifetime Colorfastness (Light and Crocking)

C. Provide flooring material to meet the following test performance criteria as tested by recognized independent testing laboratory. Certified test reports shall be submitted by the manufacturer for each test method. Requirements listed below must be met by all products being submitted for approval.

1. Pill Test / DOC-ff-1-70 (ASTM D-2859) - Requirement: Pass
2. Flooring Radiant Panel / ASTM E-648 - Requirement: Class I (Above .45 w/cm)
3. CRI VOC CHamber Test/INdoor Air Quality test (CRI-IAQ) Green Label Plus TM Test.
4. Lightfastness: Rating of not less than 5 on International Grey Scale after 40 SFU's when tested in accordance with AATCC Test Method 16E.
5. Crockfastness: Minimum stain rating on International Grey Scale of not less than 5 wet or dry when tested in accordance with AATCC Test Method 165.
6. Atmospheric Fading: Burned Gas shall not be less than 5 on INternational Grey Scale after two cycles on each test as per AATCC Test Method 129 Ozone and AATCC Test Method 23.
7. Nose Reduction Coefficient (ASTM C 423-02): NRC Rating of 0.30

8. Impact Insulation Classification (ASTM E 492-09): IIC Rating of 64
9. Slip Resistance (ASTM 1028-96): Complies with ADA Guidelines for level surface
10. Thermal Insulation (ASTM C 518): R-4
11.

PART 2 - PRODUCTS

2.1 CARPET TILE CP1

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. J&J Invision; J&J Industries, Inc. Basis of Design: Kintex Put a Cork in It
2. Patcraft; a division of Shaw Industries, Inc.
3. Shaw Contract Group; a Berkshire Hathaway company.

B. Color: Drum.

C. Pattern: Put a Cork In It.

D. Fiber Content: . Textile Composite

E. Wear Layer: Polyester Applied Pattern

F. Total Thickness: .205 inches

G. Total Weight: 4.5 oz. - 5.2 oz/ sq. ft. for finished carpet tile.

H. Primary Backing/Backcoating: Polyester Felt Cushion .

I. Size: 24 by 24 inches (610 by 610 mm).

J. Sustainable Design Requirements:

1. Sustainable Product Certification: Platinum level certification according to ANSI/NSF 140.

K. Performance Characteristics:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D7330.
2. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
3. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
4. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
5. Electrostatic Propensity: Less than 3 kV according to AATCC 134.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less.

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. in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Painted Subfloors: Perform bond test recommended in writing by adhesive manufacturer.

1. Access floor substrate is compatible with carpet tile and adhesive if any.

E. 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: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders. Monolythic installation unless otherwise noted on finish plan.

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 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Gypsum board.
2. Steel.

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

1.3 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.

1.4 DELIVERY, STORAGE, AND HANDLING

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

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

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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. Kelly-Moore Paint Company Inc.
3. Sherwin-Williams Company (The). (Promar 200 Zero VOC, Basis of Design)

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.

C. Colors: As shown on drawings.

2.1 PRIMERS

A. Interior/Exterior Latex Block Filler: Water-based, high-solids, emulsion coating formulated to bridge and fill porous surfaces of exterior concrete masonry units in preparation for specified subsequent coatings.

B. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

C. Water-Based Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, interior ferrous metals subject to mildly corrosive environments.

2.2 WATER-BASED FINISH COATS

A. Interior, Latex, Institutional Low Odor/VOC, Eggshell: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.

B. Interior, Latex, Institutional Low Odor/VOC, Semigloss: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.

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. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

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

3.2 PREPARATION

A. Comply with manufacturer's written instructions 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.

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.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Contracting Officer Representative, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Latex System, Alkyd Primer MPI INT 5.1Q:

   a. Prime Coat: Alkyd quick-dry primer for metal.
   b. Intermediate Coat: matching topcoat.
   c. Topcoat: Interior, latex, match existing gloss.

B. Gypsum Board Substrates:

1. Latex System, Alkyd Primer MPI INT 9.2A:

   a. Prime Coat: Interior latex primer sealer.
   b. Intermediate Coat: Latex, interior, matching topcoat.
   c. Topcoat: Interior, latex, match existing gloss.

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood stains.
2. Transparent finishes.

B. Related Requirements:

1. Section 099123 "Interior Painting" for stains and transparent finishes on concrete floors.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

C. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: 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. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures of less than 5 deg F (3 deg C) above the dew point, or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Behr Paint Company; Behr Process Corporation.
2. Benjamin Moore & Co.
3. Coronado Paint; Benjamin Moore & Co.
4. Lenmar Lacquers; Benjamin Moore & Co.
5. PPG Paints.
6. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
7. Sherwin-Williams Company (The).

2.2 SOURCE LIMITATIONS

A. Source Limitations: Obtain each coating product from single source from single manufacturer.

2.3 MATERIALS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

B. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings 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."

C. Stain Colors: Match Government's standard.

2.4 WOOD STAINS

A. Stain, Interior, Semitransparent, for Interior Wood: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new interior wood surfaces that are to be finished with a clear varnish.

2.5 TRANSPARENT FINISHES

A. Varnish, Interior, Water Based, Clear, Satin: Water-based clear satin coating for interior wood trim, frames, doors, paneling and cabinetry.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

C. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods to produce smooth, glasslike finish.
3. Sand surfaces exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Contracting Officer Representative, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Doors:

1. Water-Based Varnish over Stain System :

   a. Stain Coat: Stain, semitransparent, for interior wood.
   b. First Intermediate Coat: Water-based varnish matching topcoat.
   c. Second Intermediate Coat: Water-based varnish matching topcoat.
   d. Topcoat: Varnish, water based, clear, satin.

END OF SECTION

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 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.

1.8 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:
   a. Surface-Applied Graphics: Raised black characters to match Government standard
   b. Color(s): Brushed metal finish to match Government standard

2. Mounting: Manufacturer's standard method for substrates indicated with.
3. Text and Typeface: Accessible raised characters and Braille. Finish raised characters to be black, and finish Braille to match background color.

2.3 SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish 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. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.

B. Adhesive: As recommended by sign manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

D. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

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. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.6 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 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.

C. Mounting Methods:

1. Basis of design- Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position and push to engage tape adhesive.

3.2 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

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

2.3 FIRE-PROTECTION CABINET "FEC"

A. Cabinet Type: Suitable for fire extinguisherextinguisher and hose valve.

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. Activar Construction Products Group, Inc. - JL Industries.
b. Babcock-Davis.
c. Guardian Fire Equipment, Inc.
d. Nystrom.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

E. Cabinet Trim Material: Steel sheet.

F. Door Material: Steel sheet.

G. Door Style: Fully glazed panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide manufacturer's standard hinge, permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

   a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

      1) Location: Applied to cabinet door.
      2) Application Process: Pressure-sensitive vinyl letters.
      3) Lettering Color: Black.
      4) Orientation: Vertical.

K. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

   a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
   b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   c. Color: As selected by Government from manufacturer's full range.

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.
5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:

1. Fire-Protection Cabinet Mounting Height: 42 inches (1067 mm) above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply vinyl lettering at locations indicated.
2. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet mounting bracket indicated.

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

a. Activar Construction Products Group, Inc. - JL Industries.
b. Babcock-Davis.
c. Guardian Fire Equipment, Inc.
d. Nystrom.
e. Pyro-Chem; brand of Johnson Controls International plc, Building Solutions North America.

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: Manufacturer's standard.
4. Handles and Levers: Manufacturer's standard.

B. Multipurpose Dry-Chemical Type in Steel Container : UL-rated 3-A:40-B:C, 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS "FE"

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Government.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Height: Top of fire extinguisher to be at 42 inches (1067 mm) above finished floor.

END OF SECTION

SECTION 211313 - FIRE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install an automatic sprinkler system to protect the Bureau of Land Management's NIFC 100 Building located in Boise, Idaho as indicated herein and as shown on the preliminary working Plans. Connect system to a water supply of sufficient pressure to ensure full and sustained water discharge immediately from sprinklers when opened by fire at rated heat temperatures. Water supply shall conform to NFPA water supply requirements with considerations given to the reliability of the public or private water supply, taking into account probable minimum pressure conditions. The Contractor shall verify site water pressure before submitting Working Plans.

B. All portions of the systems shall be installed in accordance with the preliminary working plans, Details, and Specifications and as required by jurisdictional authorities and codes. The position is taken that the Government is entitled to a project which meets or exceeds the minimum requirements of nationally recognized fire protection standards. All efforts and installations shall be directed toward this end. Where there is conflict between the preliminary working plans and/or Specifications, and the requirements of the jurisdictional authorities or codes, the conflict shall be brought to the attention of the Government at least ten (10) days prior to Bidding or be resolved at no cost to the Government. If the Contractor has not identified conflicts to the Government, he shall be responsible for complying with the most stringent code or preliminary working drawing methods.

C. Substitution requests shall be submitted to the Government at least ten (10) days prior to Bidding and shall conform to the instructions set forth in the Substitution Procedures Section of Division 01.

D. The intent of these Specifications is to describe the complete systems to be installed, including minor details of work or materials not specifically mentioned or shown, but necessary for the successful operation and completion of the installation.

E. Work to be performed under this Section shall include, but not be limited to the following:

1. Automatic fire sprinkler systems:

a. Wet pipe flow switch system.

1) Pipe and fittings.
2) Hangers and supports.
3) Earthquake bracing.
4) Valves.
5) Alarms.
6) Flow and Tamper Switches.

7) Specialties.

F. The following areas shall be furnished with an automatic fire protection system of type or types indicated or as required:

1. Revise existing fire sprinkler system at basement and level one for renovations.

1.2 RELATED WORK

A. All work performed under this Section of the specifications shall be subject to the requirements of both the General and Special Conditions.

B. Related work specified elsewhere:

1.	Joint Fire Stopping	Section 078443
2.	Digital, Addressable Fire Alarm	Section 283111

C. Examine the complete bid document drawing set and the above referenced Specification parts thoroughly before submitting a Proposal for accomplishment of work in this Section.

1.3 REGULATORY AGENCIES

A. The term jurisdictional authority used in this Section of the Specification shall include, as applicable, but not be limited to the following:

1. Boise Building Department.
2. Boise Fire Marshal
3. Insurance Services Office or Insuring Authority Having Jurisdiction.
4. Government.

B. The design and installation of all systems of fire protection shall conform to all requirements of applicable codes and publications herein defined:

1. International Building Code (2024).
2. International Fire Code (2024)
3. NFPA 13 (2025).
4. NFPA 25 (2024).
5. NFPA 72 (2025).
6. All State and local ordinances.
7. Underwriters' Laboratories.
8. American Society of Testing Materials.
9. American National Standards Institute.

1.4 SUBMITTALS

A. The successful Contractor shall provide submittal data as required under other portions of this Specification. Submittals shall conform to the instructions set forth in the General and Special Conditions of these Specifications entitled Shop Drawings and Submittals.

1. The "Working plans" shall be submitted to the Government for approval of intent of "Preliminary Plans" per state of Idaho requirements.

B. Installer Reliability: The Installer shall possess a valid State of Idaho Fire Sprinkler Contractor's license. The Installer shall have been actively and successfully engaged in the installation of commercial automatic sprinkler systems for the past three years.

C. Materials and Equipment: All equipment and devices shall be of a make and type listed by UL, FM, or other nationally recognized testing laboratory for the specific purpose for which it is used.

D. Submit Working Plans (Floor Plans - detailed Working Plans), showing dimensions, ducts, lights, or other items affecting the fire protection systems to jurisdictional agencies for review and approval. All items identified in NFPA 13 for proper Working Plans shall be complied with. The Government will reject all Submittals not in compliance. Submit all necessary Working Plans to authorities having jurisdiction. Concurrently, six (6) sets shall be sent to the Contracting Office for review (alternately, an electronic submittal of to-scale Working Plans will be acceptable). After approvals from jurisdictional agencies have been returned to the Contractor, they shall be submitted to the Government for final acceptance. These final acceptance sets shall have all agencies' stamps of review and acceptance.

E. Working Plans shall be prepared in AutoCAD, Revit, or compatible software.

F. The Government's review will be for general location only. It will be the Contractor's responsibility to check all drawings for interferences and to do shop fabrication from measurements taken at the job site.

G. Work on the Project shall not begin until Plans have been reviewed by Government.

H. One (1) electronic submittal set of full catalog information and to-scale Working Plans shall be submitted for approval for all materials intended for use on this Project. Catalog information indicating more than one item shall be highlighted to clearly indicate the proposed equipment.

I. Record Drawings required per paragraph 1.6 and Operation and Maintenance Manuals required per paragraph 1.7 shall be submitted for approval.

J. Prepare detailed Working Plans that are signed by a NICET Level III, Level IV Sprinkler Technician or a Registered Professional Engineer practicing in the field of Fire Protection Engineering. As the Working Drawing and Calculation review is for technical adequacy only, the installer remains responsible for correcting any conflicts with other trades and building construction that arise during installation. Partial Submittals will not be accepted. Material Submittals shall be approved prior to purchase or delivery to the job site. Suitably bind

Submittals in notebooks or binders and provide index referencing the appropriate Specification Section. Submittals shall include, but not be limited to, the following:

1. Qualifications:

   a. Provide a copy of the installing Contractor's fire sprinkler state Contractor's license.
   b. Provide a copy of the NICET certification for the NICET Level III, Level IV Sprinkler Technician who prepared and signed the detailed Working Plans or the Idaho License number of the Registered Professional Engineer practicing in the field of Fire Protection Engineering.

2. Hydraulic calculations in accordance with NFPA 13 and with design information given on the preliminary working plans and in the specifications.

K. Manufacturer's Data Sheets: Provide for materials and equipment proposed for use on the system. Include listing information and installation instructions in data sheets. Where data sheet describes items in addition to that item being submitted, clearly identify proposed item on the sheet.

L. Re-submittals: A summary of submittal changes will be required for each re-submittal. This summary should briefly reiterate the original comment and give specific direction on how the issue was resolved. Changes made that are not a result of submittal review comments shall be clearly identified in this summary as well.

1.5 JOB CONDITIONS

A. The Contractor shall investigate the structural, mechanical, electrical, and finished conditions affecting the piping, and shall arrange the equipment accordingly; furnish required fittings, offsets and accessories. Route fire protection piping to avoid interference with duct work and drain piping. In the event it becomes necessary to make field changes in pipe locations due to building construction, the Contractor shall consult with the Government before making any changes. Any such changes required shall be made without added cost to Government.

B. The Contractor shall determine, and be responsible for, the proper locations and type of inserts for hangers, chases, sleeves, and other openings in the construction required for fire protection work, and shall obtain this information well in advance of the construction progress to avoid delay of the work.

C. All fees and permits specifically required for fire protection work, not obtained by others as specified elsewhere shall be applied for and paid for by this Contractor.

D. All systems of fire protection shall be installed by a licensed (for the location of installation) Fire Protection Contractor, fully experienced in fire protection installation as specified herein. Fire Protection Contractors may be required to provide in writing, specific information as to successfully completed projects and references to show cause as to why they should be considered acceptable to the Government.

E. Fire protection system shutdowns shall be coordinated and implemented by the Contractor as preplanned impairments per NFPA 25 Chapter 15 and its related Annexes. Where any fire protection system will be placed out of service for more than 10 hours in a 24-hour period, an approved fire watch shall be provided until the system is restored to normal working order. Impairments shall be coordinated with the Government and other trades to minimize conflict and inconvenience.

1.6 RECORD DRAWINGS

A. One approved set of preliminary working plans and one set of Working Plans shall be maintained on the job at all times.

B. One set of "As-Built" Drawings shall be kept on the job at all times. "As-Built" Drawings shall be kept current daily. "As-Built" Drawings shall be available at all times to Government for review and use.

C. One reproducible set of "As-Built" Drawings shall be provided to the Government upon completion of the work.

1.7 OPERATION AND MAINTENANCE MANUALS

A. One (1) set electronic submittal of operating and maintenance instructions shall be provided to the Government upon completion. Manuals shall include, as a minimum, the following:

1. "As-Built" Drawings.
2. Revised hydraulic calculations based on "As-Built" Drawings.
3. Catalog cut sheets of all materials installed.
4. Equipment maintenance manuals.
5. Contractor's Material and Test Certificates.
6. Certification of Government Training.
7. Contractor Guarantee and Warranty.
8. "As-Built" AutoCAD drawing (.dwg) file or equal on CD disk.

B. One (1) factory-bound edition of NFPA 25 shall be provided to the Government.

1.8 TRAINING

A. The Fire Protection Contractor shall instruct the Government in the operation of the systems. Instruction shall continue until the Government is fully satisfied and understands the operation of the system.

B. Contractor shall obtain Government's dated signature that all training has been accomplished and is acceptable to the Government.

1.9 GUARANTEES AND WARRANTIES

A. The Fire Protection Contractor shall guarantee to the Government in writing, all equipment and workmanship for a period of one (1) year after the fire protection system has been placed in continuous service and has been accepted by all authorities having jurisdiction.

B. The Fire Protection Contractor shall not be held responsible for improper or negligent maintenance by the Government after operating and maintenance indoctrination has been given to the Government.

PART 2 - PRODUCTS

2.1 SPRINKLERS

A. Acceptable Manufacturers:

1. Tyco.
2. Victaulic.
3. Viking.
4. Reliable.

B. Install sprinklers from reviewed Working Plans.

C. All sprinklers shall be of similar design and from a single manufacturer.

D. The operating temperature of sprinklers shall be as required by the specific location of installation.

E. Extended coverage sprinklers shall not be used unless specified in the preliminary working plans.

F. Sprinklers shall conform to the requirements of NFPA 13, as indicated in the preliminary working plans, and as follows:

1. Brass upright or pendent may be used in all attic, mechanical, storage or other non-public spaces.
2. Recessed shall be used in all finished areas, offices, patient rooms, etc. unless otherwise noted.
3. Where surface mounted obstructions will not allow for recessed installation, two-piece escutcheons may be used to extend sprinklers to a maximum deflector distance as allowed by NFPA or U.L. listing with prior approval of the Government.
4. Sidewall sprinklers may be used in accordance with listing and jurisdictional requirements.
5. All sprinklers shall be quick-response glass bulb type when applicable.
6. Dry pendent sprinklers shall be used in all areas subject to freezing when the sprinklers are supplied from a heated area wet system.

7. Sprinklers with deflectors less than 7-feet-6-inches above the finished floor shall have sprinkler guards.
8. Pendent sprinklers in mechanical rooms, electrical rooms, and janitor closets shall have sprinkler guards.

G. Escutcheons for seismic areas shall be oversized expansion plate type to allow 1 inch clearance

2.2 FLEXIBLE SPRINKLER HOSE FITTINGS

A. Acceptable Manufacturers:

1. FlexHead Industries, Inc.
2. VicFlex Victaulic.

B. Flexible sprinkler hose fittings for use in commercial suspended and gypsum board ceilings may be used as a contractors' option to hard pipe armover and drops per NFPA and installed per the manufacturers' listing.

C. All flexible sprinkler hose fittings shall be UL listed and FM approved.

D. Provide flexible hose assemblies and end fittings with 100 percent Type 304 Stainless steel, with a 175 psi maximum rated pressure. Flexible hose assemblies shall be fully welded non mechanical fittings, braided, leak tested with minimum 1inch true bore internal corrugated hose diameter.

E. Flexible hose assemblies shall have G90 galvanized steel ceiling bracket, direct attachment type, having integrated snap on clip ends positively attached to the ceiling using tamper resistant screws. Provide flexible hose attachment with removable hub type with set screw.

2.3 PIPE AND FITTINGS-INTERIOR

A. Interior piping for automatic sprinkler system shall conform to NFPA 13 and as follows:

1. Pipe and fittings shall be products manufactured in the United States of America.
2. Wet system sprinkler piping above ground with threaded fittings shall be Schedule 40 black steel pipe with a corrosion resistance rating equal to or greater than 1.0. Threaded thinwall pipe with a CRR less than 1.0 shall not be used.
3. Fittings for threaded and coupled pipe shall consist of cast iron, ductile iron, or malleable threaded fittings joined with Teflon tape thread sealing compound or pipe joint compound per manufacture installation requirements. Pressure rating of fittings shall be as required for application.
4. Wet system sprinkler piping above ground with grooved fittings for sizes 2-1/2-inch and larger shall be roll grooved Schedule 10 black steel pipe with a corrosion resistance rating equal to or greater than 1.0

5. Fittings for grooved end pipe shall consist of Tyco Grinnell Series ductile iron or equal ductile iron couplings and fittings in accordance with NFPA 13. Gaskets shall be as recommended by the manufacturer for the application.

B. Fittings for plain end pipe shall not be used.

C. Mechanical Outlet or Strap Outlet type fittings shall not be used in new system installations. Mechanical Outlet acceptable to tie to existing piping. U-bolt style not acceptable

D. CPVC piping shall not be used.

E. Alternate piping systems approved by NFPA 13 may be allowed with prior approval of the Government.

F. All piping shall be identified with pre-manufactured piping identification labels.

G. All drain piping and fittings shall be galvanized.

2.4 HANGERS AND SUPPORTS

A. Space pipe hangers in accordance with the requirements of NFPA 13. Construct hangers, hanger rods, inserts and clamps as approved by the same.

2.5 EARTHQUAKE BRACING

A. Furnish and install all earthquake bracing as required by NFPA 13, Authority Having Jurisdiction, Government's insurer, and as follows:

1. Seismic Coefficient (Cp) force factor requirements are provided and shown on the preliminary working plans.
2. In structures of seismic design categories D the requirements for the hangers and piping shall follow the requirements of ASCE standard 7-10.
3. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

2.6 VALVES

A. Acceptable Manufacturers:

1. Mueller.
2. Kennedy.
3. Nibco.
4. Tyco.
5. AGF.
6. United Brass.
7. Victaulic.

8. Watts.

B. Gate valves shall be approved indicating type as required by NFPA 13. Check valves shall be as required by NFPA 13. Test and drain valves shall be approved brass globe, angle, or ball valves. Locate sprinkler system isolation valves as shown on the drawings and as required per NFPA 13 complete with a tamper alarm switch.

C. Interior:

1. Ball Valve:

a.	Make:	Watts
b.	Sizes:	1/4-inch to 2 inches.
c.	Ends:	Threaded.
d.	Model:	WBV

2. Drain Valves Interior:

a.	Make:	United Brass
b.	Sizes:	1/2-inch through 2 inches.
c.	Ends:	Threaded.
d.	Model:	125 SUL

2.7 SPECIALTIES

A. Fire Seals:

1. Where piping passes through walls, floors or other building construction which by code requires a fire rating, approved fire rated assemblies shall be used. Proposed protection shall be submitted for approval. Plans shall clearly indicate details and locations of required protection.

B. Escutcheon Plates:

1. Where exposed piping passes through finish work, chrome plated wall plates or other wall plate finishes acceptable to the Government, shall be installed. All wall plates shall be metal.
2. Split wall plates or escutcheons shall only be used in remodel projects. Split wall plates or escutcheons shall be installed to fit snugly around piping. All wall plates shall be metal.
3. Solid galvanized wall plates shall be used at both sides of all exterior walls.

C. Valve Identification:

1. All valves within the building shall have permanently marked identification signs provided in accordance with NFPA 13 standards. Signs shall be manufactured and not hand written. Signs shall be hung with galvanized or chrome chain.

D. Piping Identification:

1. All piping shall be identified at 40' maximum spacing and a minimum of one identification label per room. Labels shall be Seton wrap around style or equal.

2.8

PART 3 - EXECUTION

3.1 DESIGN CRITERIA

A. Working Plan Information: Provide working plans, calculations, materials, equipment, installation, inspection, and testing of the automatic sprinkler system in accordance with the requirements of NFPA 13 and the following:

1. Recommendations in annexes shall be treated as requirements.
2. Sprinkler Protection: To determine spacing and sizing, apply the following coverage classifications:

   a. See occupancy design table and notes on the preliminary working plans.
   b. Request clarification from Government for any hazard classification not identified.

3. Perform hydraulic calculations in accordance with NFPA 13 utilizing the Area/Density method. Provide a hydraulic placard for each zone, occupancy hazard, and each floor of the building minimum.
4. The room design method is not allowed unless indicated in the preliminary working plans.
5. Quick response sprinkler reductions are not allowed unless indicated on the preliminary working plans.
6. Minimum design areas shall be 1500 sf, unless otherwise indicated on the preliminary working plans.
7. Flexible sprinkler assemblies shall be included in hydraulic calculations using the UL listing equivalent length of Schedule 40, nominal 1 inch diameter pipe, with a minimum of three (3) bends.
8. Hydraulic calculated demand including hose stream requirements shall fall no less than 10 psi below the available water supply curve.
9. Velocities shall not exceed 20 feet per second in any pipe.
10. Water Supply: Base water supply on a flow test as indicated on the preliminary working plans.

B. The preliminary working plans indicate approximate locations of sprinklers and conceptual routing of piping. Final spacing and layout is the responsibility of this contractor and final approval of the layout and routing is to be by the Government.

C. The fire protection system supplier shall design the piping to supply the system. Piping shall be laid out so as not to interfere with the installation of other piping, ductwork, light fixtures, or equipment.

D. The entire sprinkler system is not shown on Plans. The intent is to provide complete sprinkler systems as required. This Contractor shall be responsible for surveying the site, existing construction, new construction, and the complete contract document set and prepare Working Plans for the total system.

E. All piping shall be run concealed wherever possible. Where piping is run exposed, special notation on Contractor's Working Plans to that effect shall be evident and conspicuous on the Working Plans. Any piping determined to be a problem shall be relocated at no cost to the Government.

F. System piping to be hydraulically calculated in accordance with Chapter 28.

3.2 INSTALLATION

A. Furnish sprinkler system with the following components:

1. Systems shall be equipped with a supervised isolation valve and an approved flow alarm connected to the building fire alarm system.
2. A main drain shall be installed on each riser or sectional zone control valve and shall drain to the exterior or to an adequate drain connection.
3. Auxiliary drains shall be provided when a change in piping direction prevents drainage of sections of branch lines or mains through the main drain valve.
4. A test pipe of not less than 1 inch diameter terminating in an orifice equivalent to one sprinkler shall be provided for each system or sectional zone.
5. Exterior alarm shall be installed as near as practical to Fire Department Connection with identification sign. Exterior horn/strobe shall be wired to alarm system.

B. Installation shall be accomplished by the licensed Contractor. Provide a qualified technician, experienced in the installation and operation of the type of system being installed, to supervise the installation and testing of the system.

C. Delivery, storage, and handling of materials to and on the construction site shall be consistent with good practices, manufacturers' requirements, and the following procedures. Components shall be protected from moisture, dirt, and debris. Storage shall be elevated above grade and protected from damage. Provide adequate ventilation to prevent condensation. Deliver piping and valves with protective caps installed; if removal of protection is required for inspection, reinstall for storage. Store piping in a manner to prevent sagging or bending. Any deficiencies discovered in the delivery, storage, or handling of materials shall be recorded and remedied immediately in such a way as to minimize damage and preserve the integrity of the system and components.

D. Installation of Piping:

1. Ensure the ends of all sprinkler system pipes are smooth and free of any burrs or fins. To help reduce the potential for accelerated internal pipe corrosion of longitudinally welded black steel pipe, install such pipe with the weld line rotated at least 45 degree in relationship to the floor (for reference, the weld line points at the floor at 0 degree).
2. Accurately cut pipe to measurements established by the installer and work into place without springing or forcing. In any situations where bending of the pipe is required, use a standard pipe-bending template.
3. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
4. Install concealed piping in spaces that have finished ceilings. Pipe installed near equipment shall not block or encroach on equipment access or impede maintenance. Where ceiling mounted equipment exists, install sprinklers so as not to obstruct the movement or operation of the equipment or block access. Sidewall sprinklers may need to be utilized.
5. Locate piping in stairways as near to the ceiling as possible to prevent tampering by unauthorized personnel, and to provide a minimum headroom clearance of seven feet six inches. To prevent an obstruction to egress, provide piping clearances in accordance with NFPA 101.
6. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 inches and larger end connections.
7. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
8. 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:

    a. Apply appropriate tape or thread compound to external pipe threads.
    b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

9. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

E. Installation of Valves:

1. Install unions adjacent to each valve in pipes NPS 2 inches and smaller.
2. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
3. Install valves in horizontal piping with stem at or above the pipe center.
4. Install valves in position to allow full stem movement.

F. Welding: Conform to the requirements and recommendations of NFPA 13.

G. Drains: Pipe drains to discharge at safe points outside of the building or to sight cones attached to drains of adequate size to readily carry the full flow from each drain under maximum pressure. Do not provide a direct drain connection to sewer system or discharge into sinks. Install drum drips and drains where necessary and required by NFPA 13. Locations of drains

shall be indicated on shop and as-built drawings. A map of all drain locations shall be permanently affixed to a visible location near the fire riser to aid in their identification.

H. Affix cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections to the respective waterflow switch or pipe connection near to the pipe from where they were cut.

I. Sleeves: Provide for pipes passing through masonry or concrete Schedule 10 pipe. Provide space between the pipe and the sleeve in accordance with NFPA 13. Seal this space with a UL Listed through penetration fire stop material per UL assembly listings.

J. Seals: Seal all interior fire rated wall penetrations with fire caulk. Seal all exterior wall penetrations with fire calk or foam insulation and silicone sealing to maintain the fire rating and thermal/moisture integrity of the wall system.

K. Securely attach identification signs and tags to control valves, drain valves, and test valves. Locate hydraulic placard information signs at each sectional control valve where there is a zone water flow switch. A map of any isolation valves installed in the building at locations other than on the fire riser in the riser room shall be permanently affixed to a visible location near the fire riser to aid in their identification.

L. Repair damage to the building or equipment resulting from the installation of the sprinkler system by the installer at no additional expense to the Government.

M. Where details of installation are not given, the installation shall be made using manufacturer's recommended practices or at the direction of the Government.

N. This Contractor shall complete the fire protection systems ready for operation, in all respects, as soon as possible. When system is complete and ready for continuous operation, activate the system for its intended use. After system has been activated for continuous use, water charges will be paid by the Government.

O. This Contractor shall remove from the building all rubbish and unused materials due to or connected with this installation. This contractor is responsible for proper removal and disposal of all demolition items, as indicated on the plans or no longer required for a complete operational system, in conformance with the Division 01 - General Requirements.

P. All piping and components shall be cleaned and left ready for painting in good condition and free of damage, leakage, and corrosion.

3.3 TESTING

A. This Contractor shall call for inspection and complete Contractor's Material and Test Certificates per NFPA 13 "Systems Acceptance". The Forms shall be signed by the Authority Having Jurisdiction.

B. The new piping of the sprinkler system shall be hydrostatically tested at not less than 200 psig pressure for a period of not less than two (2) hours with no pressure drop in the system. Test

blanks shall be used per NFPA 13. The existing system shall be tested at the working pressure per NFPA 13.

C. All testing shall be witnessed by the Government.

D. Where jurisdictional authority's or NFPA 13 standards are more stringent than the above test, they shall prevail.

END OF SECTION 211313

Cushing Terrell

OWNER'S INFORMATION CERTIFICATE

Name / Address of property to be protected with sprinkler protection:
BLM NIFC 100 Building
Boise, Idaho

Name of Owner: Bureau of Land Management

Existing or planned construction is:

- ☒ Fire resistive or noncombustible
- ☐ Wood frame or ordinary (masonry walls with wood beams)
- ☐ Unknown

Is the system installation intended for one of the following special occupancies:

Aircraft hangar	☐Yes	☒No
Fixed guideway transit system	☐Yes	☒No
Race track stable	☐Yes	☒No
Marine terminal, pier, or wharf	☐Yes	☒No
Airport terminal	☐Yes	☒No
Aircraft engine test facility	☐Yes	☒No
Power plant	☐Yes	☒No
Water-cooling tower	☐Yes	☒No

If the answer to any of the above is "yes" the appropriate NFPA standard should be referenced for sprinkler density / area criteria.

Indicate whether any of the following special materials are intended to be present:

Flammable or combustible liquid	☐Yes	☒No
Aerosol products	☐Yes	☒No
Nitrate film	☐Yes	☒No
Pyroxylin plastic	☐Yes	☒No
Compressed or liquefied gas cylinders	☐Yes	☒No
Liquid or solid oxidizers	☐Yes	☒No
Organic peroxide formulations	☐Yes	☒No
Idle pallets	☐Yes	☒No

If the answer to any of the above is "yes" describe type, location, arrangement, and intended maximum quantities.

Indicate whether the protection is intended for one of the following specialized occupancies or areas:

Spray area or mixing room	☐Yes	☒No
Solvent extraction	☐Yes	☒No
Laboratory using chemicals	☐Yes	☒No
Oxygen-fuel gas system for welding or cutting	☐Yes	☒No
Acetylene cylinder charging	☐Yes	☒No
Production or use of compressed or liquefied gasses	☐Yes	☒No
Commercial cooking operation	☐Yes	☒No
Class A hyperbaric chamber	☐Yes	☒No
Cleanroom	☐Yes	☒No
Incinerator or waste handling system	☐Yes	☒No
Linen handling system	☐Yes	☒No
Water-cooling tower	☐Yes	☒No

If the answer to any of the above is "yes" describe the type, location, arrangement, and intended maximum quantities.

Will there be any storage of products over 12 ft. (3.6 m.) in height? ☐Yes ☒No

If the answer is "yes" describe product, intended storage arrangement, and height.

Will there be any storage of plastic rubber or similar products over 5 ft. (1.5 m.) high except as described above?

☐Yes ☒No

If the answer is "yes" describe product, intended storage arrangement, and height.

Assumptions:

I certify that I have knowledge of the intended use of the property and that the above information is correct.

Signature of Owner's Representative or Agent: Cushing Terrell Inc. - See stamped Preliminary Working Plans

Date: 11/24/2025

Relationship and firm of Agent (please print): Fire Protection Engineer

SECTION 230500 - COMMON WORK RESULTS FOR PLUMBING AND 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 SUMMARY

A. This Section includes the following:

1. Record Documents, Maintenance Manuals, and General Provisions for mechanical work.
2. Piping materials and installation instructions common to most piping systems.
3. Transition fittings.
4. Dielectric fittings.
5. Sleeves.
6. Escutcheons.
7. Mechanical Sleeve Seals.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Supports and anchorages.

1.3 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing by the Contracting Officer and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified without added cost to Project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.4 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."

1.5 FEES AND PERMITS

A. Contractor shall apply and pay for all permits, inspections, reviews, etc. required by the authorities having jurisdiction.

1. The Contractor shall include in his/her Bid all system development or similarly named fee imposed by the serving utility company or governing entity (City, County, etc.).

1.6 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements in Division 01 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (ie. traps, strainers, tanks, etc.). Refer to Section 230553 "Identification for Plumbing and HVAC Piping and Equipment". Indicate actual inverts and horizontal locations of underground piping.
3. Equipment locations (exposed and concealed) dimensioned from prominent building lines.
4. Approved substitutions, Contract Modifications, and actual equipment and materials installed. Revise equipment schedules.
5. Contract Modifications, actual equipment and materials installed.

1.7 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01 Section "PROJECT CLOSEOUT." In addition to the requirements specified in Division 01. Assemble O & M Manuals as follows:

1. Compile three copies of Operating and Maintenance Manuals for the mechanical systems and equipment. The manuals shall be provided to the Contracting Officer for approval complete and at one time, prior to requesting final payment. Partial or separate data will be returned for completion.
2. Manuals shall be assembled in three-ring binders. Binders shall be 3 inches thick or less and more than one binder shall be used for each set of data if required to prevent overfilling of one binder. Binders shall have plastic coating with correct name of the Project permanently attached to the spine. All information shall be arranged in Sections

and each Section shall have a blank buff colored, heavy paper divider with a protruding tab clearly labeled. Sections shall be arranged in the same order that the equipment is listed in the Specification and each Specification Section shall have a separate tab. Shop Drawings which are larger than 8-1/2 inches by 11 inches shall be individually folded so they are 8-1/2 inches by 11 inches or less and inserted behind the appropriate tab.

3. Tabs shall be labeled and arranged as follows:

   a. Index: Furnish under the first tab an index of Sections listing name of Section and Specification numbers.
   b. Equipment Manufacturers: Furnish under the second tab a complete typed list of equipment suppliers and manufacturers representative including type of equipment, name, address and phone number. The company listed here should be the one which could furnish replacement parts and offer technical information about the equipment.
   c. Product Literature: Each tab, starting with the fourth shall contain the name of a Specification Section. Behind each tab shall be the previously submitted and approved Shop Drawing, factory published operation and maintenance instructions and parts lists.

4. Upon completion and approval of the booklets, one copy shall be given to the Contracting Officer, and two to the Government. Using the booklet, the Mechanical Contractor shall explain in detail and instruct the Government's operating personnel in the correct operation and maintenance of the equipment.

1.8 GENERAL PROVISIONS FOR MECHANICAL WORK

A. Interferences: Project design took into account potential interferences between trades (e.g. mechanical ductwork with piping or with electrical light fixtures), however, not every interference has been eliminated. It shall be the responsibility of the Bidder and potential Contractor to field verify all mechanical piping and duct routing, making allowances for existing beams, pipes, ducts, hangers, and other obstructions. Provide HVAC duct offsets and transitions as required maintaining duct aspect ratios within 10 percent of design. The cost associated with interferences shall be included in the Base Bid.

B. Examination of Project Drawings:

1. The Drawings (Plans, elevations, flow schematics, etc.) for the mechanical work are intended to convey Scope of Work and to indicate the general arrangements and locations of end-use equipment, systems, etc., and the approximate sizes thereof.
2. The Contractor shall determine the exact location and mounting heights of equipment, rough-ins, and the exact routing and positioning of piping/ductwork equipment so as to best fit the layout of the job. Scaling of the Drawings will not be sufficient for determining these locations. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made, by the Contractor, at no additional cost to the Client.
3. Because of the scale of the Drawings, certain basic items/materials and quantities thereof, (e.g. fittings, connectors, flanges, unions, pipe wells, couplings, hangers, sleeves, clamps, screws, hooks, inserts, pipe/duct mounted - meters, gauges, sensors, etc.) may not be

shown, but where such items are required by other Sections of the Specifications or where they are required for proper installation of the Work, such items shall be furnished and installed and the cost thereof, reflected in the Base Bid.

4. The determination of quantities of HVAC and plumbing end-use systems and equipment required shall be made by the Contractor from the Drawings. Interferences and quantities and locations of basic items/materials may not be indicated on the Drawings and will require field verification and determination by the Contractor.
5. The Contractor shall coordinate the location and method of support of the piping/duct systems with that of all installations under other Divisions and Sections of the Specifications.

PART 2 - PRODUCTS

2.1 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. 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.

C. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

D. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.2 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.

2.3 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic or carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

B. 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.

C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

D. Install piping to permit valve servicing.

E. Install piping to allow application of insulation.

F. Select system components with pressure rating equal to or greater than system operating pressure.

G. Install escutcheons for penetrations of walls, ceilings, and floors.

H. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

I. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.3 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.

D. Install equipment to allow right of way for piping installed at required slope.

3.4 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

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.

1.2 SUMMARY

A. This Section includes basic requirements for factory-installed and field-installed motors.

1.3 DEFINITIONS

A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain field-installed motors of a single type through one source from a single manufacturer.

B. 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.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:

    a. Magnetic controllers.
    b. Multispeed controllers.
    c. Reduced-voltage controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

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.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply to factory-installed motors except as follows:

1. Different ratings, performance, or characteristics for a motor are specified in another Section.
2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.2 MOTOR CHARACTERISTICS

A. Motors 3/4 HP and Larger: Three phase.

B. Motors Smaller Than 3/4 HP: Single phase.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for open drip proof motors; 1.0 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

G. 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.

H. Enclosure: Totally enclosed fan cooled (TEFC).

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: AC polyphase induction motors NEMA Nominal Efficiency shall meet or exceed the efficiency standards listed. The NEMA Nominal Rating is identified on the motor nameplate.

			Motors (full load)
HP	1200	RPM 1800	3600
5	87.5	87.5	87.5
7.5	89.5	89.5	88.5
10	89.5	89.5	89.5
15	90.2	91.0	90.2
20	90.2	91.0	90.2
25	91.7	92.4	91.0
30	91.7	92.4	91.0
40	93.0	93.0	91.7
50	93.0	93.0	92.4
60	93.6	93.6	93.0
75	93.6	94.1	93.0
100	94.1	94.5	93.6
125	94.1	94.5	94.5
150	95.0	95.0	94.5
200	95.0	95.0	95.0

C. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

H. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.

1. Finish: Gray enamel.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush 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. Designed with critical vibration frequencies outside operating range of controller output.
2. Temperature Rise: Matched to rating for Class B insulation.
3. Insulation: Class H.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with nonhygroscopic material.

1. Finish: Chemical-resistant paint over corrosion-resistant primer.

D. Source Quality Control: 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. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
C. 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.

D. 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.

END OF SECTION 230513

SECTION 230523 - GENERAL-DUTY VALVES FOR PLUMBING AND HVAC 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 SUBMITTALS

A. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions

1.3 QUALITY ASSURANCE

A. Single-Source Responsibility: Comply with the requirements specified in Division 01 Section "Materials and Equipment," under "Source Limitations" Paragraph.

B. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

D. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components" - Health Effects; for valves materials that will be in contact with potable water.
3. Comply with NSF 372, "Drinking Water System Components" - Lead Content.

PART 2 - PRODUCTS

2.1 BASIC, COMMON FEATURES

A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.

1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

E. Provide any wetted parts of valves that come in contact with potable water shall comply with NSF 61 and NSF 372.

2.2 BALL VALVES

A. Ball Valves, 2 Inches and Smaller: MSS SP-110, Class 150, 600 psi CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch valves and smaller and conventional port for 3/4-inch valves and larger; blowout proof; bronze or brass stem; Teflon seats and seals.

1. Operator: Vinyl-covered steel lever handle.
2. Stem Extension: For valves installed in insulated piping.

B. End Connection: Threaded.

2.3 CHECK VALVES

A. Swing Check Valves, 2 Inches and Smaller: MSS SP-80; Class 125, 200 psi CWP, or Class 150, 300 psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat.

B. End Connection: Threaded.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until 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 from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

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. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves as indicated, according to manufacturer's written instructions.

B. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above the center of the pipe.

E. Install valves in a position to allow full stem movement.

F. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Horizontal position with hinge pin level.
2. Silent Check Valves: Horizontal or vertical position.
3. Lift Check Valve: With stem upright and plumb.

3.3 VALVE END SELECTION

A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2 Inches and Smaller: Threaded ends.

3.4 APPLICATION SCHEDULE

A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements. Select trim to suit piping systems:

B. Domestic Water Systems: Use the following valve types.

1. Ball Valves: Class 150, 600 psi CWP, with stem extension.
2. Check Valves: Class 125, swing or wafer type as indicated.

C. Heating Water Systems: Use the following valve types.

1. Ball Valves: Class 150, 600 psi CWP, with stem extension and memory stop.

2. Bronze Swing Check: Class 150, with composition seat.

3.5 ADJUSTING

A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR PLUMBING AND 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.

1.2 SUMMARY

A. Section Includes:

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

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 SUBMITTALS

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

B. Shop Drawings: For multiple piping supports and trapeze hangers, show fabrication and installation details and include calculations. Details shall indicate connections to equipment, piping and structure.

C. Welding certificates.

1.5 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Thermal-Hanger shield inserts shall be installed at the time of hanger installation.

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 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.
   c. Flex-Strut Inc.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut Corporation; Tyco International, Ltd.
   g. Wesanco, Inc.

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: Electroplated zinc.
8. Paint Coating: Acrylic.
9. Plastic Coating: Epoxy.

2.3 THERMAL-HANGER SHIELD INSERTS

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. Carpenter & Paterson, Inc.
2. ERICO International Corporation.
3. Mechanical Pipe Shields "SNAP-ITZ."
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. TOLCO a brand of Nibco.
10. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig or water-repellent treated, ASTM C 533, Type I calcium silicate, minimum compressive strength and vapor barrier.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

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

2.6 VRF SYSTEM 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:

1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Hardware: Galvanized steel or polycarbonate.
4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Vertical Members: Two, stainless-steel, continuous-thread 1/2-inch (12-mm) rods.
4. Horizontal Member: Adjustable horizontal, stainless steel pipe support channels.
5. Pipe Supports: Roller, Strut clamps. Clevis hanger or Swivel hanger.
6. Hardware: Stainless steel.
7. Accessories: Protection pads.
8. Height: 12 inches above roof.

2.7 VRF SYSTEM OUTDOOR EQUIPMENT STANDS

A. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly assembled on-site.

B. Foot Material: Rubber or polypropylene.

C. Rails Material: Hot-dip galvanized carbon steel.

D. Wind/Sliding Load Resistance: Up to 100 mph minimum.

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: 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.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Installed by Mechanical Contractor at time of hanger installation. Inserts are required on all cold piping 2 inches and larger.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 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.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert for pipes 2 inches and larger. Run insulation continuously through hanger and install a galvanized Type 40 insulation shield between hanger and insulation for pipes smaller than 2 inches.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Where indicated, install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier smaller than 2 inches. Shields shall span an arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048-inch thick.
   b. NPS 4: 12 inches long and 0.06-inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06-inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for 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.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for cold insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

Pipe Size	Pipe Material	MSS Hanger Type	Manufacturer/Model	Notes
1/2" - 4"	Bare Steel	Type 1	ANVIL Fig. 65	
5" - 14"	Bare Steel	Type 1	ANVIL Fig. 260	
1/2" - 4"	Bare Copper	Type 9	ANVIL Fig. CT-99 or CT-65	
1/2" - 4"	Insulated Copper (Hot)	Type 9	ANVIL Fig. CT-99 or CT-65	
1/2" - 12"	Insulated Steel (Hot)	Type 1	ANVIL Fig. 300	Hanger may contact pipe.
1/2" - 1-1-2"	Insulated Copper and Steel (Cold)	Type 1	ANVIL Fig. 300 with shield	No pipe contact allowed.
2" - 12"	Insulated Copper and Steel (Cold)	Type 1	ANVIL Fig. 300 with shield and insert	No pipe contact allowed.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 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 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. 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): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 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.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230549 - SEISMIC CONTROLS FOR PLUMBING AND 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 SUMMARY

A. This Section includes the following:

1. Seismic snubbers.
2. Restraining braces and cables.
3. Restrained isolators.

B. It is the intent of this section to have the seismic bracing requirements designed by the approved seismic equipment manufacturer and installed by the mechanical contractor. The seismic manufacturer shall be responsible for the structural design of attachment hardware as required to attach snubbers to both the equipment and supporting structure. The manufacturer shall submit seismic shop drawings showing type and location of restraint devices as required to meet the code and performance requirements specified herein. The work under this section shall include all materials and labor necessary for complete execution of installation of seismic restraint assemblies as required per IBC code requirements.

C. The requirements of this seismic restraint section are in addition to other requirements as specified for support and attachment of equipment and mechanical services.

1.3 DEFINITIONS

A. IBC: International Building Code.

1.4 PERFORMANCE REQUIREMENT

A. Seismic-Restraint Loading:

1. Reference structural drawing S001 for Seismic Design requirements.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting seismic restraints. Certification documents to be signed and sealed by a qualified Professional Engineer with at least 5 years experience in the design of seismic restraints.
2. Seismic Restraint Details: Detail submittal drawings of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration anchors.
3. Seismic Shop Drawings: Floor Plans indicating seismic bracing locations and spacing for HVAC piping, ductwork and equipment.

1.6 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

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

C. Seismic restraint products shall be of the same manufacturer.

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. All piping and ductwork is to be retrained to meet code requirements. The seismic restraint manufacturer will provide documentation on maximum restraint spacing for various cable sizes and anchors. In addition, the seismic restraint manufacturer will provide support documentation containing adequate information to allow the installation contractor to make reasonable field modifications to suit special case conditions.

F. Seismic Restraint Designers/Manufacturers: Subject to compliance with requirements provide seismic design services and products by one of the following:

1. Amber/Booth Co. Inc.
2. Kinetics Noise Control.
3. Mason Industries.

PART 2 - PRODUCTS

2.1 RESTRAINED ISOLATORS

A. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or 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.

B. 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 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: Seismic or limit stop as required for equipment and authorities having jurisdiction.
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.

2.2 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least **four** times the maximum seismic forces to which they will be subjected.

B. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.

2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch thick resilient cushion.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized steel cables pre-stretched with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

F. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic 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 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on shop drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Installation of all seismic restraint materials shall be installed according to the manufacturer's installation instructions and project shop drawings.

B. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure. Snubbers are not needed if restrained isolators are used.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports and longitudinal supports as required for the site spectral response.
3. Brace a change of direction longer than 12 feet.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. 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.
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.

END OF SECTION 230549

SECTION 230553 - IDENTIFICATION FOR PLUMBING AND 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.

1.2 SUMMARY

A. This Section includes the following mechanical and plumbing identification materials and their installation:

1. Equipment markers.
2. Pipe markers.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

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 location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:

   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 inches: 3/4-inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other related Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment.

1. Letter Size: Minimum 1/4-inch for name of units if viewing distance is less than 24 inches, 1/2-inch for viewing distances up to 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. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    b. Fans, blowers, mixing boxes and VAV boxes.
    c. Packaged HVAC central-station air handling units.
    d. Tanks and pressure vessels.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4-inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
2. Pipes with OD, Including Insulation, 6 inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. Locate pipe markers where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; exterior nonconcealed locations and concealed ceiling spaces as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and nonaccessible 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. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings at intervals of 50 feet.

3.4 CLEANING

A. Clean faces of mechanical identification devices.

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 SUMMARY

A. This Section includes TAB to produce design objectives for Building 100 remodel area and HVAC units.

B. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

2. Balancing VRF Systems

3. Control system verification.

1.3 SUBMITTALS

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Sample Report Forms: Submit two sets of sample TAB report forms.

C. Final TAB Report.

1.4 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by NEBB.

B. The Test and Balance Contractor shall be an independent consultant. The firm shall be independent of all Contractors including the Subcontractors.

C. TAB Conference: Meet with Governments and Contracting Officer's representatives to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and

other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

    a. Submittal distribution requirements.
    b. The Contract Documents examination report.
    c. TAB plan.
    d. Work schedule and Project-site access requirements.
    e. Coordination and cooperation of trades and subcontractors.
    f. Coordination of documentation and communication flow.

D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

E. TAB Report Forms: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.5 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

D. For VRF systems, TAB Contractor shall be required to meet with VRF HVAC system manufacturers Service Representative. Service Representative shall provide the TAB Contractor all of the training, instructions, and setup materials needed to properly set up the indoor units for the project, including but not limited to fan speed, external static pressure, and variable fan operation (if applicable).

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 system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

E. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

F. Examine equipment for installation and for properly operating safety interlocks and controls.

G. 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. Complete system readiness checks and submit a system readiness report to the Contracting Officer. Verify the following:

1. Permanent electrical power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
6. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Determine the best locations in main ducts for accurate duct airflow measurements.

C. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

D. Verify that motor starters are equipped with properly sized thermal protection.

E. Check dampers for proper position to achieve desired airflow path.

F. Check for airflow blockages.

G. Check condensate drains for proper connections and functioning.

H. Check for proper sealing of air-handling unit components.

I. Check for proper sealing of air duct system at connections of new air-handling unit.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. 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. 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.
4. 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.

3.6 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each replacement packaged air handling unit and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.

2. Check the following for each unit:

    a. Measure airflow of the units.
    b. Verify that balancing devices are marked with final balance position.
    c. Document initial inspection, test and balance and deviations from the Contract Documents in initial report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Contracting Officer.
2. The TAB contractor's test and balance personnel shall conduct the inspection in the presence of Contracting Officer.
3. Contracting Officer 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.
4. 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."
5. 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.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. 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, Government may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.7 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.
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.

3.8 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 percent.

3.9 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed by the testing and balancing contractor.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Government agency name and address.
6. Contractor's name and address.
7. Report date.
8. Signature of TAB firm who certifies the report.
9. Table of Contents with the total number of pages defined for each Section of the report. Number each page in the report.
10. 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.

11. Notes to explain why certain final data in the body of reports varies from indicated values.
12. Test conditions for fans performance forms including the following:

a. Settings for outside-, return-, and relief-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. Settings for supply-air, static-pressure controller.
f. Other system operating conditions that affect performance.

13. For VRF systems, report shall include the following:

a. For indoor units, document the fan speed “set value” measured external static pressure, and measured airflow rate for each fan speed. Set medium speed for rated airflow, and low / high speed for lower / higher airflows. Verify all airflow settings and static pressure readings do not fall above or below the manufacturers published airflow tables.

3.10 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Contracting Officer.

B. Contracting Officer 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, Government 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, Government may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

END OF SECTION 230593

SECTION 230700 - PLUMBING AND HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes Plumbing pipes, refrigerant pipes, and HVAC duct insulation.

1.2 SUBMITTALS

A. Product data for each type of mechanical insulation identifying k-value, thickness, jackets (factory and field applied) and accessories.

1.3 QUALITY ASSURANCE

A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

1. Interior to Building Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
2. Exterior of Building Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

1.4 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for Plumbing and HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct installation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation.

1.5 SEQUENCING AND SCHEDULING

A. Schedule insulation application after pressure testing of piping and duct systems.

B. Thermal-hanger shield inserts are specified in "Hangers and Supports." Inserts shall be installed at the time of hanger installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Glass Fiber:

   a. CertainTeed Corporation.
   b. Knauf Fiberglass.
   c. Manville/Schuller.
   d. Owens-Corning Fiberglas Corporation.
   e. E-Insulation.

2. Flexible Elastomeric Cellular:

   a. Armacell LLC.
   b. IMCOA Corporation.
   c. Rubatex Corporation.

2.2 GLASS FIBER

A. Material: Inorganic glass fibers, bonded with a thermosetting resin.

B. Jacket: All-service, factory-applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil skrim backing having pressure sensitive self-sealing lap.

C. Board: ASTM C 612, Class 2, semi-rigid jacketed board.

1. Thermal Conductivity: 0.23average maximum, at 75 deg F mean temperature.
2. Density: 3.0 pcf average maximum.

D. Blanket: ASTM C 553, Type I, Class B-2, jacketed flexible blankets.

1. Thermal Conductivity: 0.27 at compressed thickness, at 75 deg F mean temperature.
2. Density: 0.75lb/cu. ft.

E. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, factory applied all-service jacket with self seal lap.

1. Thermal Conductivity: Refer to Pipe Insulation Conductivity Schedule in Part 3.
2. Density: 5 lb/cu. ft average maximum.

F. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

2.3 FLEXIBLE ELASTOMERIC CELLULAR

A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.

1. Tubular Materials: ASTM C 534, Type I.
2. Sheet Materials: ASTM C 534, Type II.

B. Thermal Conductivity: Refer to Pipe Insulation Conductivity Schedule in Part 3.

C. Coating: Water based latex enamel coating recommended by insulation manufacturer.

2.4 ADHESIVES

A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer. Comply with MIL-A-24179A, Type II, Class 1.

2.5 FIELD APPLIED JACKETS

A. Aluminum Jacket: ASTM B 209, 3003 Alloy, H-14 temper, roll stock ready for shop or field cutting and forming to indicated sizes.

1. Finish and Thickness: Smooth finish, 0.016-inch thick for interior applications and 0.020-inch (0.51mm) thick for exterior applications.
2. Moisture Barrier for Outdoor Applications: 3 mil thick, heat-bonded polyethylene and kraft paper.
3. Elbows: Preformed 45-degree and 90-degree, short- and long-radius elbows, same material, finish, and thickness as jacket.

2.6 ACCESSORIES AND ATTACHMENTS

A. Bands: 3/4-inch wide, in one of the following materials compatible with jacket:

1. Aluminum: 0.007-inch thick.
2. 1/8-inch by 1/8-inch Rapid Penetrating point screws for non vapor barrier application.

B. Wire: 14 gauge nickel copper alloy, 16 gauge, soft-annealed stainless steel, or 160 gauge, soft-annealed galvanized steel.

C. Cupped Head Weld Pins- 1-1/2-inch diameter cupped head, mild, annealed steel with zinc plating.

D. Corner Angles: 28 gauge, 1-inch by 1-inch aluminum, adhered to 2-inch by 2-inch kraft paper.

E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

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

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

G. Foil/Skrim/Kraft Tape: Vapor barrier tape with rubber adhesive and UL listed and 25/20 rated.

1. Width: 2 inches
2. Thickness: 3.7 mils.
3. Adhesion: 85 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 45 lbf/inch in width.

2.7 SEALING COMPOUNDS-MASTIC

A. Vapor Barrier Compound: Water-based, fire-resistive composition.

1. Water Vapor Permeance: 0.08 perm maximum.
2. Temperature Range: Minus 20 to 180 deg F.

B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.

1. Water Vapor Permeance: 0.02 perm maximum.
2. Temperature Range: Minus 50 to 250 deg F.
3. Color: Aluminum.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.

3.2 INSTALLATION, GENERAL

A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.

C. Install vapor barriers on insulated pipes, ducts, and equipment where indicated and defined in insulation service chart.

D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

E. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.

F. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

G. Keep insulation materials dry during application and finishing.

H. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors for ducts and pipes.
2. Testing laboratory labels and stamps.
3. Nameplates and data plates.
4. Access panels and doors in air distribution systems.
5. Chrome-plated pipes and fittings, except for plumbing fixtures for the disabled.
6. Backflow prevention device.

3.3 PIPE INSULATION INSTALLATION, GENERAL

A. Tightly butt longitudinal seams and end joints.

B. Apply insulation continuously over fittings, valves, and specialties.

C. Apply insulation with a minimum number of joints.

D. Apply insulation with all service jackets as follows:

1. Pull jacket tight and smooth.
2. Cover circumferential joints with butt strips, at least 3 inches wide, and of same material as insulation jacket.
3. Longitudinal Seams: Overlap seams at least 1-1/2-inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
4. At penetrations in jackets for thermometers and pressure gauges, fill and seal voids with mastic.
5. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.

E. Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapor barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket for exterior insulation outside roof

flashing at least 2 inches below top of roof flashing. Seal metal jacket to roof flashing with vapor barrier coating.

F. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with firestopping or fire-resistant joint sealer.

G. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor.

H. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with mastic. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight.

1. Use same material and thickness as adjacent pipe insulation.
2. Overlap nesting insulation by 2 inches or 1-pipe diameter, which ever is greater.
3. Insulate elbows with blanket insulation inserts.
4. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.

I. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. For vapor barrier application piping, extend insulation on anchor legs a minimum of 12 inches and taper and seal insulation ends.

1. Install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer. Refer to "Hangers and Supports" for thermal-hanger shield inserts.
2. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

3.4 GLASS FIBER PIPE INSULATION INSTALLATION

A. Seal exposed seams and joint ends, with mastic.

3.5 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION

A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, use longitudinally precut insulation and apply to the pipe. Seal seams and joints with adhesive.

B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive. Use prefabricated fittings if available.

1. Miter cut materials to cover soldered elbows and tees.
2. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

3.6 DUCT INSULATION

A. Install block and board insulation as follows:

1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12 inches apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound. Install metal corner angles on all outside corners to provide a neat finished appearance.
2. Speed Washers or Weld Pins Attachment: Secure insulation tight and smooth with speed washers or welded pin attachments. Space anchor pins 18 inches apart each way and 3 inches from insulation joints. Apply mastic to insulation in contact, open joints, breaks, punctures, and voids in insulation.

B. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:

1. 24 Inches and Larger: Anchor pins spaced 12 inches apart each way.
2. Overlap joints 3 inches.
3. Seal joints, breaks, and punctures with vapor barrier tape, matching jacket material.

3.7 FIELD APPLIED JACKETS

A. Install metal jacket with 2 inch overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel draw bands 12 inches on center and at butt joints.

3.8 FINISHES

A. Exterior insulated ductwork and equipment shall have a weatherproof coating applied over the insulation.

B. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of manufacturer's recommended protective coating to exposed insulation.

3.9 INSULATION SCHEDULES

A. General: Abbreviations used in the following schedules include:

1. Field-Applied Jackets: PVC - PVC, A - Aluminum.
2. Pipe Sizes: NPS - Nominal Pipe Size.
3. Materials: GF - Glass Fiber, FE - Flexible Elastomeric.

B. Pipe Insulation:

1. Thermal Conductivity: Pipe insulation conductivities for Glass Fiber piping shall be within the ranges tabulated in the Pipe Insulation Conductivity Schedule below. Refer to Part 2 for required conductivity of other pipe insulation materials.
2. Pipe Insulation Schedule: Pipes shall be insulated according to their application and size, per the Pipe Insulation Schedule below.

PIPE INSULATION CONDUCTIVITY SCHEDULE		
FLUID OPERATING TEMP (ºF)	INSULATION CONDUCTIVITY BTU*IN/(H*FT²*ºF)	MEAN RATING TEMP (ºF)
> 350	0.32 - 0.34	250
251 - 350	0.29 - 0.32	200
201 - 250	0.27 - 0.30	150
141 - 200	0.25 - 0.29	125
105 - 140	0.21 - 0.28	100
40 - 60	0.21 - 0.27	75
< 40	0.20 - 0.26	75

NOTES:

1. THIS TABLE DOES NOT APPLY TO CALCIUM SILICATE INSULATION, DUCTWORK / EQUIPMENT INSULATION, OR FIRE PROTECTION SYSTEM INSULATION. REFER TO PART 2 FOR INSULATION CONDUCTIVITY REQUIREMENTS FOR THESE SYSTEMS.

PIPE INSULATION SCHEDULE							
APPLICATION	TEMP (°F)	NOM. PIPE SIZE (IN.)	INSUL. MAT.	THICK NESS (IN.)	INSERTS OR SHIELDS (NOTE 1)	VAPOR BARR.	FIELD APP. JKT.

DOMESTIC COLD WATER	ALL	ALL	GF OR FE	1	NO	YES	NONE
DOMESTIC HOT WATER AND HW RECIRC	ALL	<1-1/2 1-1/2 AND UP	GF OR FE	1 1-1/2	NO	NO	NONE
RAIN WATER AND OVERFLOW	ALL	ALL	GF OR FE	1	NO	NO	NONE
REFRIGERANT SUCTION AND HOT GAS	ALL	BELOW 1 1 AND UP	FE FE	1/2 1	NO	NO	SEE NOTE 2-A

NOTES:

1. INSERTS AND SHIELDS ARE IN SECTION 230529 - HANGERS AND SUPPORTS FOR PLUMBING AND HVAC PIPING AND EQUIPMENT AND SHALL BE PROVIDED BY THE INSULATION CONTRACTOR.

2. ALL PIPING INSTALLED OUTDOORS OR EXPOSED TO WEATHER SHALL HAVE A FIELD APPLIED JACKET, EVEN IF A JACKET IS NOT EXPLICITLY CALLED OUT IN THIS TABLE.

C. Duct Systems: Ductwork shall be insulated per the Duct Systems Insulation Schedule below.

DUCT SYSTEMS INSULATION SCHEDULE					
APPLICATION	TYPE	INSUL. MAT.	R-VALUE	VAPOR BARRIER	FIELD APPLIED JACKET
VRF INDOOR SUPPLY DUCTWORK INSTALLED IN CEILING PLENUMS, ATTICS, OR OTHER UNCONDITIONED SPACES.	BLANKET	GF	6	NO	NONE

INDOOR SUPPLY AND RETURN DUCTWORK IN OPEN CEILING SPACES	NOT REQUIRED				
DOAS OUTDOOR DUCTWORK (SUPPLY, RETURN AND EXHAUST) TO MEET IECC	BOARD	GF	12	YES	A
GENERAL EXHAUST DUCTWORK (INSIDE BUILDING)	NOT REQUIRED				

END OF SECTION 230700

SECTION 230900 - INSTRUMENTATION AND CONTROL 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 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for heating and cooling units that are not supplied with factory-wired controls.

B. Controls contractor to salvage all removed building automation DDC components to BLM/NIFC facility.

C. Remove all existing electric and pneumatic controls, panels, conduit, wiring, etc., which are replaced by new DDC controls. Removal shall include all hangers, etc.

1.3 SYSTEM DESCRIPTION

A. General: The control system shall be as indicated on the drawings and described in the Specifications. The Contractor shall provide hardware, software, and programming necessary to implement the functions and sequences of operation on this project utilizing direct digital control (DDC) technology.

B. Existing DDC system: The existing DDC system for NIFC 100 ADM Building, Boise, Idaho is manufactured by Johnson Controls. Existing control shop drawings are available from Contracting Officer. Provide all labor, materials, and software necessary to connect existing system to new work described in this specification and the Contract Drawings.

C. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.

D. The system will consist of an open architecture that utilizes EIA standard 709.1, the integral ANSI / ASHRAE™ Standard 135-1995 "BACnet" functionality to assure interoperability between all system components.

E. The software tools required to network manage ANSI / ASHRAE™ Standard 135-1995, BACnet protocol must be provided with the system. Minimum BACnet compliance is Level 3;

with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via MSTP.

1.4 SUBMITTALS

A. Product Data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, installation instructions, and startup instructions. Provide manufacturer's cut sheets with the data specifically applicable to the project highlighted or clearly indicated and referenced to each Control Drawing.

B. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, required clearances, components, size, and location of each field connection.

C. Shop Drawings containing the following information for control system:

1. Schematic flow diagram showing fans, pumps, coils, dampers, valves, and control devices.
2. Each control device labeled with setting or adjustable range of control.
3. Diagrams for all required electrical wiring. Clearly differentiate between factory-installed and field-installed wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
7. Listing of connected data points, including connected control unit and input device.
8. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
10. Software description and sequence of operation.
11. Temperature control contractor (TC) will coordinate, review and edit the terminal unit controller points list for NIFC ADM 100 Building HVAC system. TC shall add, adjust or rebind all graphics as necessary to reflect floor plan and HVAC system upgrades. TC shall add trends on all control points that shall be repositoried into the server for long term storage.

D. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring. TC as built submittal package shall include locations of all new communication cable.

E. ANSI / ASHRAE Standard 135-1995, BACnet PIC Statement: Proof of Compliance Level 3 or higher is required.

F. Maintenance data for control systems equipment to include in the operation and maintenance manual specified in Division 01. Include the following:

1. Maintenance instructions and spare parts list for each type of control device and compressed air stations.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

G. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors for all equipment within Building 215 scope.

H. Price List: Submit manufacturers price lists for all component parts and a letter stating the multiplier to be used for future parts purchased.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer specializing in control system installations who is a factory authorized dealer for an approved manufacturer. The installer shall be a Johnson Controls factory authorized installer that is routinely involved in Metasys control system installations.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing control systems similar to those indicated for this Project and that have a record of successful in-service performance.

C. Startup Personnel Qualifications: Engage specially trained personnel in direct employ of manufacturer of primary temperature control system.

D. Comply with NFPA 90A, NFPA 70 and the National Electric Code.

1.6 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project developed hardware and software shall become the property of the Government. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation.

PART 2 - PRODUCTS

2.1 APPROVED CONTRACTORS / MANUFACTURERS

A. The Facility is part of a multi-building campus. The equipment and modifications shall be compatible with the existing Campus Johnson Control systems and shall be installed by one of the following:
1. Johnson Controls; by Johnson Controls, Inc.; Boise, ID

2. Johnson Controls; by Harris; Boise, ID

2.2 DIRECT DIGITAL CONTROL (DDC) EQUIPMENT AND SOFTWARE

A. Operator Interface: Existing PC based workstation located in BLM NIFC campus maintenance area able to access all information in the system over LAN communication system.

B. Direct Digital Control System: Provide an Extended Architecture model DDC system as manufactured by Johnson Controls, with latest software revisions. Provide system shall communicate with and integrate seamlessly with the existing JCI virtual server system site director located on the BLM-NIFC campus located in Boise, Idaho. The existing DDC system is Johnson Controls, Inc. with Extended Architecture. The scope of the DDC work shall include interface and monitoring of VRF system, dedicated outside air unit and variable volume units for demand control sequence and verify incorporate multiple communication protocol to connection.

1. Input/output capability from operator station for monitoring and controlling all of the points listed in the input/output point list. The operator shall be able to monitor and access all points by means of clear concise English names without having to understand or reference hardware point locations or controller programs.
2. Real-Time Displays. The user interface shall at a minimum, support the following graphical features and functions:

    a. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the user interface shall support the use of scanned pictures.
    b. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
    c. Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.
    d. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

3. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu.
4. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value.
5. System Configuration. At a minimum, the user interface shall permit the operator to perform the following tasks, with proper password access:

    a. Create, delete or modify control strategies.
    b. Add/delete objects to the system.
    c. Tune control loops through the adjustment of control loop parameters.
    d. Enable or disable control strategies.
    e. Generate hard copy records or control strategies on a printer.

f. Select points to be alarmable and define the alarm state.
g. Select points to be trended over a period of time and initiate the recording of values automatically.

6. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
7. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
8. Alarm Console:

a. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
b. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

C. Integration:
1. Hardwired:
a. All controls interface critical to the operation of equipment shall be hard-wired to the DDC system. Including but not limited to VFD's, boilers, chillers, and air handlers.

2. BACnet Protocol Integration:
a. When 3rd party BACnet controls connectivity is required, connection is used to acquire additional operational and monitoring parameters not critical to the control of the equipment. All 3rd party communication shall reside on an IP network or a dedicated 3rd party MSTP communication network. When both MS/TP communications and IP communications integration options are available, IP communication is preferred.

2.3 COMMUNICATIONS

A. Sub-networks: Network communications between global controllers and unitary / application specific controllers shall be peer to peer, MSTP operating at 38.4K.

1. Operating protocol over the sub-network shall be BACnet compatible.

B. The Government's existing network system may be used as a communication media including connectors, repeaters, hubs, and routers necessary for the inter-network back to the central archive unit. The communication media with in each building will not be over the Government's existing LAN. A 100 Base T jack shall be provided adjacent to each controller and PC Workstation for connection to this network. The Contractor shall work with the Government's IT department to determine correct network addresses and other information as required to make the system operational over the existing Ethernet system.

C. All Building Controllers shall have a communications port for connections with the operator interfaces. This may be a port for Point to Point connection, a network interface node for connection to the Ethernet communications port which supports MSTP.

D. Connection of an operator interface device to any one controller on the network will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the network.

2.4 CONTROLLERS

A. Global Digital Controllers (GDC):

1. There is a Supervisory Controller, Johnson Controls Extended Architecture, M4 SNE11001-0 series existing in 100 Building. Through this supervisory controller, controls contractor shall map all available control points from update and installation of FEC controllers and VRF interface into the existing Johnson Controls Metasys UI building automation system.

2.5 INPUT DEVICES

A. General Requirements:

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors:

1. General Requirements:

a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
b. The temperature sensor shall be of the resistance type and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	**Accuracy**

Point Type	Accuracy
Room Temp	± .5 deg F.
Duct Temperature	± .5 deg F.

2. Room Temperature Sensors:
   a. Room sensors shall be constructed for wall box mounting.
   b. Room sensors shall have the following options:
      1) Stainless steel wall plate with no adjustment or display. Room set point changed from Operator interface only.
      2) Stainless steel wall plate with momentary push-button for timed override requests, or custom programming sequence. Room set point changed from Operator interface only.
3. Room Temperature Sensors with Integral Display:
   a. Room sensors shall be constructed for either surface or wall box mounting.
   b. Room sensors shall have an integral LCD display and keypad with the following capabilities:
      1) Display room temperatures and outside air temperature
      2) Display and adjust room comfort setpoint
      3) Display and adjust fan operation status
      4) Timed override request push button with LED status for activation of after-hours operation.
      5) Display controller mode
      6) Facility Operator adjustment of setpoint limits and override modes

4. Outside Air Sensors:
   a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
   b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
   c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

5. Duct Mount Sensors:
   a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
   b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
   c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

6. Averaging Sensors:
   a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
   b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.

c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

7. Building Differential Air Pressure Applications (-0.25 inch to +0.25 inch w.c.):
   a. The differential pressure transmitter shall be of industrial quality and transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal in response to variation of differential pressure or air pressure sensing points.
   b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
      1) Up to -0.25 to +0.25 w.c. input differential pressure ranges adjustable. (Select -0.10 inches to +0.10 inches for building pressure applications.
      2) 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output.
      3) Maintain accuracy up to 20 to 1 ratio turndown.
      4) Reference Accuracy: +0.2 percent of full span.
      5) Provide transmitter with display
   c. Acceptable Manufacturers: Setra or Equal.

8. Duct Air Pressure Applications (0 inch to 5 inches w.c.):
   a. The differential pressure transmitter shall be of industrial quality and transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal in response to variation of differential pressure or air pressure sensing points.
   b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
      1) (0.00 - 1.00 inch to 5.00 inch) w.c. input differential pressure ranges. (Select range appropriate for system application.)
      2) 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal
      3) Reference Accuracy: +0.2 percent of full span.
      4) Provide transmitter with display
   c. Acceptable Manufacturers: Setra or Equal.

C. Status and Safety Switches:
   1. General Requirements:
      a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the FMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

   2. Current Sensing Switches:
      a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
      b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.

c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

3. Air Filter Status Switches:

a. Differential pressure switches used to monitor air filter status shall be analog type transmitters with adjustable setpoints in the workstation.
b. A complete installation kit shall be provided, including: static pressure tips, tubing, fittings, and air filters.
c. Provide appropriate scale range and programmed alarms for intended service.

4. Air Flow Switches:
a. Differential pressure flow switches shall be bellows actuated snap acting micro-switches with appropriate scale range and differential adjustment for intended service.

5. Air Pressure Safety Switches:
a. Air pressure safety switches shall be of the manual reset type with DPDT contacts rated for 2 amps at 120 VAC.
b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
c. Acceptable Manufacturers: Cleveland Controls or equal.

2.6 Output Devices

A. Control Relays:
1. Control Pilot Relays:
a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
b. Mounting Bases shall be snap-mount.
c. DPDT, 3 PDT, or 4 PDT relays shall be provided, as appropriate for application.
d. Contacts shall be rated for 10 amps at 120 VAC.
e. Relays shall have an integral indicator light.
2. Control Power Relays:
a. SPDT, DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
b. Contacts shall be rated for the proper resistive, inductive, or motor HP load.
c. Relays shall have an integral indicator light.

2.7 CONTROL CABLE

A. All low voltage control cabling shall be Plenum rated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

3.2 PROGRAMMING

A. The Control contractor shall upload any existing control system information including schedules, set points and alarm data and print an all points log for data reference input to the new controller. Implement all features of programs to specified requirements and as required to satisfy the sequence of operation. Provide programming and adjustments required during the test and balance and building startup and warranty period.

B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.

C. Software Programming: Provide customized programming to fully utilize the specified software. This includes, but is not limited to, things such as run time data on all equipment, maintenance scheduling, energy consumption tracking, energy conservation programming demand limiting, etc. It is the intent of this Specification to provide the building users with an EMCS system that utilizes the full capabilities of the system with no programming by the user.

D. Operator's Interface:

1. Standard Graphics. Provide colored graphics for each defined control system. These standard graphics shall show all points dynamically as specified in the points list. At a minimum there shall be the following graphical screens:

    a. Floor Plans: Building floor plans indicating all major controlled components including but not limited to air handlers, sensors, fans, coils, pumps, and other major equipment components.
    b. Systems: Generate graphic screens similar to the control shop drawings for each local controller including but not limited to individual air handling systems, cooling plant, heating plant, and generator systems.
    c. Calendar time schedule graphical screens.
    d. All point information shall be readily accessible on each graphical system screen including but not limited to set point and actual conditions, operating status, override, runtime, actuator position and alarm conditions.
    e. Field equipment views showing all components of the equipment being controlled such as VAV boxes. Graphics shall include all dampers valves and other points related to each controlled device.

2. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this Section. This includes any operating system software, the operator interface database, and any third party software installation and integration required for successful operation of the operator interface.

3.3 INSTALLATION

A. Install equipment as indicated to comply with manufacturer's written instructions.

B. Install labels and nameplates to identify control components according to Section 230500 "Common Work Results for Plumbing and HVAC" specifying mechanical equipment identification.

3.4 ELECTRICAL WIRING AND CONNECTIONS

A. FMS Wiring:
   1. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the TC Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the TC Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
   2. Class 2 Wiring:
      a. All Class 2 (24 VAC or less) wiring in mechanical rooms and exposed areas shall be installed in conduit unless otherwise specified.
      b. Class 2 wiring in concealed accessible locations shall be in EMT conduit or shielded plenum rated cable. Class 2 wiring not installed in conduit shall be neatly bundled, installed parallel to the building structural lines, and supported every 5 feet from the building structure using hangers designed for this application, such as D-rings or J-hooks. All wiring shall be installed in accordance with local code requirements.
   3. Class 2 signal wiring and 24 VAC power can be run in the same conduit. Power wiring 90 VAC and greater cannot share the same conduit with Class 2 signal wiring.
   4. Provide for complete grounding of all applicable signal and communications cables, panels, and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
   5. Provide line and low voltage wiring, control transformers, and miscellaneous devices required for a complete and functional EMCS and control system. Include control wiring, conduit, connections between field devices and panel devices, control and equipment panels, control transformers, electrical starter and safety circuit connections and interlock wiring. All conduit, wiring, accessories and wiring connections required for the installation of the Facility Management System including power wiring for all controllers shall be provided by the TC Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this Section.
   6. Fasten flexible conductors, bridging cabinets and doors, neatly along hinge side; protect against abrasion. Tie and support conductors neatly.
   7. Number-code or color-code conductors, except local individual room controls, for future identification and servicing of control system.

B. When the building is equipped with an emergency power system, power and control circuits shall be obtained from emergency panels.

C. Connect electrical components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

D. HVAC Input Devices - General:

1. All Input devices shall be installed per the manufacturer recommendation.
2. Space Sensors:

a. Shall be mounted per ADA requirements.

3.5 APPLICATION SOFTWARE DOCUMENTATION

A. Provide blueprint documentation of the software application program for each controller. Documentation provided shall include block software flowchart showing the interconnection between each of the control algorithms and sequences. For systems utilizing program listings, a program listing shall be printed onto the same blueprint, along with the program flowchart, and description of the sequence of operation. This blueprint shall be stored and maintained in each DDC device panel. System acceptance shall not be completed until this documentation is provided and located in each panel.

B. Provide a copy of all databases on CD or tape backup. Provide a CD of all graphic screens created for the Project.

3.6 ACCEPTANCE TESTING

A. Point Verification:

1. To verify end-to-end operation of the system, provide a hard copy of All Points Summary Listing to the Government of each part or system to be placed in warranty by the Government.
2. Controls contractor shall delete points from removed controllers from the BMS.

B. Sequence Verification:

1. The Contractor shall notify the Government's representative when the systems are performing all specified sequences. The Contractor shall demonstrate to the Contracting Officer every specified feature of the DDC system, the Contracting Officer shall verify all sequences of operation and allow the system to be placed into warranty acceptance test.

a. Verification of sequence of operation shall take place on site. The temperature control contractor shall provide a laptop computer for connection to the global control panel. The control technician shall simulate conditions and change set points as directed by the Contracting Officer to verify all sequences.

b. Demonstration: Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with Specification and Drawings.

1) Contracting Officer and Government Representative may be present to observe and review system demonstration. Notify Contracting Officer at least 10 days before system demonstration begins.
2) Demonstrate actual field operation of each sequence of operation. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Contracting Officer. Provide and operate test equipment required to prove proper system operation.
3) Demonstrate complete operation of operator interface.
4) Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

2. The warranty acceptance test shall be of 7 days' duration and the system shall perform as follows:

a. During the 7 days, the EMCS system shall not report any system diagnostics from the subsystem under test.
b. The subsystem shall be performance verified as operational using temporary trends of each control loop located in the SDC. During the occupied periods, EMCS control loops under test shall maintain control of the process variable within the following scales:

Duct Static Pressure: +/- .05-inch wc.
Differential Pressure Control: +/- 10 percent of control range.
Duct Temperatures: +/- 2 deg F.
Room Temperatures: +/- 1 deg F.

c. The Contractor shall set up trending on any process variables that are specially requested by the Contracting Officer in order to verify that system is meeting the Contracting Officer's design intent. Trend printouts shall be legible and time and date stamped for each variable. Duration and frequency of process variables shall be determined by the Contracting Officer.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to start control systems.

B. Test and adjust controls and safeties.

C. Replace damaged or malfunctioning controls and equipment.

D. Start, test, and adjust control systems.

E. Demonstrate compliance with requirements.

F. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.8 DEMONSTRATION

A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to demonstrate and train Government's maintenance personnel as specified below.

1. Train Government's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
2. Schedule training with Government with at least 7 days' notice.
3. Provide operator training on data display, alarm, and status descriptors, requesting data, execution of commands, and request of logs. Include a minimum of 6 hours dedicated instructor time on-site.

3.9 SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

A. Sequence of operation is defined on the Contract Drawings as the manner and method by which controls function. Requirements for each type of control system operation are specified on this drawing.

END OF SECTION 230900

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including Division 01 Specifications Section 010000 Requirements and Information apply to this Section.

1.2 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications. It includes by VRF systems and split system air-conditioning system applications.

1.3 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.

B. Refer to Section 238128 “Variable Refrigerant Flow Systems” for requirements on VRF Piping.

C. Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

B. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

1.5 COORDINATION

A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, PLUMBING & HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.

C. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Refrigerants:

a. Allied Signal, Inc./Fluorine Products; Genetron Refrigerants.
b. DuPont Company; Fluorochemicals Div.
c. Elf Atochem North America, Inc.; Fluorocarbon Div.
d. ICI Americas Inc./ICI KLEA; Fluorochemicals Bus.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR.

B. Annealed-Temper Copper Tube: ASTM B 280, Type ACR.

C. Wrought-Copper Fittings and Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.3 PRE-INSULATED REFRIGERANT LINE SETS

A. Pre-insulated refrigerant line sets maybe used in lieu of rigid ACR Pipe for VRV and split system AC systems in sizes 7/8 inch and under. Insulation shall meet ASTM E84 Flame/Smoke rating of 25/50 and have a minimum of ½ inch thick of flexible elastomeric polyethylene or closed cell foam insulation complying with Division 23 “PLUMBING & HVAC Insulation”

2.4 REFRIGERANT PIPING SPECIALTIES

A. Flexible Connectors: 500 psig maximum operating pressure; seamless tin-bronze or stainless-steel core, high-tensile bronze braid covering, with solder end connections and synthetic covering; dehydrated, pressure tested, minimum 7 inches long.

2.5 REFRIGERANTS

A. Type as noted on Drawings and VRF HVAC system.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Aboveground, within Building: Type ACR drawn-copper tubing and/or pre-insulated line sets.

3.2 PIPING INSTALLATION

A. Install refrigerant piping according to ASHRAE 15.

B. Basic piping installation requirements are specified in Section 230500 "Common Work Results for Plumbing and HVAC."

C. Adhere to VRF and split system AC manufacturer's installation requirements.

D. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

E. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

F. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

G. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

H. Slope refrigerant piping only as directed by equipment and manufacturer.

I. When brazing, 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.

J. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for Plumbing & HVAC Piping and Equipment."

K. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4-inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4-inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4-inch.
4. NPS: 1-1/4: Maximum span, 96 inches: minimum rod size, 3/8-inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8-inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8-inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size 3/8-inch.
8. NPS 3: Maximum span 120 inches; minimum rod size 3/8-inch.

L. Support vertical runs at each floor.

M. Remove flared fittings from all indoor units. Provide brazed connection and provide sufficient pipe loop to compensate for thermal movement of pipe. Refer to Drawings and specific requirement listed in Section 238128 “Variable Refrigerant Flow Systems” for additional information.

3.3 PIPE JOINT CONSTRUCTION

A. Braze joints according to Section 230500 "Common Work Results for Plumbing and Plumbing & HVAC."

B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

3.4 FIELD QUALITY CONTROL

A. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.

1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.

    a. System shall maintain test pressure at the manifold gage throughout duration of test.
    b. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
    c. Fill system with nitrogen to raise a test pressure of 150 psig or higher as required by authorities having jurisdiction.
    d. Remake leaking joints using new materials and retest until satisfactory results are achieved.

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 SUMMARY

A. Section Includes:

1. Single-wall round ducts and fittings.

2. Rectangular ducts and fittings.

1.3 DEFINITIONS

A. NUSIG: National Uniform Seismic Installation Guidelines.

1.4 WORK INCLUDED

A. Provide an installed duct system which will supply the air quantities indicated by the Drawings and have the lowest possible friction loss with the least possible leakage loss. System static pressure loss for each system shall not exceed that which is indicated in the equipment schedule as external static pressure or in the fan schedule as static pressure and shall include the losses of all accessories. Friction losses shall be minimized by reduction in the number of offsets and elbows by pre-planning the duct system installation and coordination with other trades to prevent interferences. Maintain access to accessories requiring maintenance, service, and inspection. Radius elbows are preferred for turns to minimize friction, noise, and vibrations, and especially for sections having large volume or higher velocities and sections which may have turbulence.

B. Provide and/or construct materials, ductwork, joints, transformations, splitters, dampers, and access doors as specified herein for the sheet metal ductwork as shown on Drawings.

1.5 SUBMITTALS

A. Shop Drawings:

1. Ductwork fabrication shop standards.
2. Fittings.

3. Reinforcement and spacing.
4. Seam and joint construction.
5. Duct accessories, including access doors and panels.
6. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

1.6 QUALITY ASSURANCE

A. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

B. Joint and Seam Tape: Not acceptable.

C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Water-Based Joint and Seam Sealant: One-part flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

A. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.5 ROUND DUCT AND FITTING FABRICATION

A. Round, Spiral Lock Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

1. Manufacturers:

a. Accu-Duct.
b. McGill AirFlow Corporation.
c. Norlock.
d. Omniduct.
e. SEMCO Incorporated.
f. Ventline.
g. Sheet Metal Contractors, Inc.

B. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.

   a. Manufacturers:

      1) Ductmate Industries, Inc.
      2) Lindlab Inc.
      3) McGill AirFlow Corporation.
      4) SEMCO Incorporated.
      5) Sheet Metal Contractors, Inc.

C. 90 Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts. Tees shall be conical. Saddle taps or straight tees shall not be used.

D. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

E. Two piece mitered elbows shall not be used.

F. The leading edge of all vanes in ducts over 20-inch diameter is to be hemmed with 1/2-inch foldback. Turning vanes in ducts over 24 inches are to be reinforced by stays or sectional construction to limit unsupported length to 24 inches. Vanes shall be minimum of 20 gauge.

G. Reduction of divided flow fittings to conical span section in the 36 common reductions in sizes 4-inch through 22-inch.

H. Galvanized areas damaged by welding to be coated with corrosion resistant aluminum paint.

I. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2 to plus 2-inch wg:

   a. Ducts 3 to 36 Inches in Diameter: 22 gage.

3. 90 Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
4. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45 and 90 degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate

nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

5. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
6. Round Elbows Larger than 14 Inches in Diameter Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
7. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 20 gage thick with 2-piece welded construction.
8. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.

2.6 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Available Manufacturers:

a. Ductmate Industries, Inc.
b. Nexus Inc.
c. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Available Manufacturers:

a. Ductmate Industries, Inc.
b. Lockformer.

2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant (only on all medium and high pressure ductwork).

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 12 inches and larger and 20 gage or less, with more than 10 sq. ft. of nonbraced panel area.

E. Transitions:

1. Do not exceed 1 inch in 7 inches of slope for increase-in-area transitions.
2. Do not exceed 1 inch in 4 inches of slope for decrease-in-area transitions, 1 inch in 7 inches is preferable.
3. Do not exceed 45 degrees on the entering or leaving side for angle of transitions at connections to equipment without the use of approved vanes.

F. Elbows:

1. Fabricate elbows using one of the following Specifications: The fabrication methods are listed in order of preference. Use radius elbows wherever possible. Use square elbows only when available space prevents the use of radius elbows.

    a. Unvaned, long radius elbow with the throat radius equal to 3/4 of the width of the duct and with a full heel radius.
    b. Six-inch throat radius with full radius, single thickness vanes and full heel radius.
    c. Square elbows with airfoil, double thickness turning vanes.
    d. Maximum unsupported length of vanes shall be 36 inches. Securely fasten vanes to runners. Secure vanes in stable position. Construct vane edges to project tangents parallel to duct sides.

2. Turning Vanes:

    a. True airfoil design; smoothly-rounded entry nose with extended trailing edge. Generated sound power level shall not exceed 54 decibels in band 4 at 2000 FPM in a 24 inch x 24 inch duct.
    b. Basis of Design: Equal to Aero/Dyne Co., High Efficiency Profile, HEP. Contact Aero/Dyne Co. at 1215 High Street, Suite 103, Auburn, CA 95603. (Telephone #800-522-2423).
    c. Fabricate assemblies with side rails; install vanes on design centers of 2.4 inches across the full diagonal dimension of the elbow.
    d. Submit manufacturer's product data for review.

G. Branch Connections:

1. Pressure Classification 2 Inches and Less:

    a. Rectangular branch from rectangular main: 45 degree entry with all corners closed as shown in Figure 4-6.
    b. Round branches: High-efficiency take-offs if shown on Drawings, otherwise use spin-in fitting without scoop.
    c. Parallel flow branches: See Figure 4-5.
    d. Space duct joints to avoid cutting them for branch take offs and outlet collars.

2. Pressure Classification Above 2 Inches:

    a. Round Branches: Conical round fittings only.

b. Rectangular branch from rectangular main: 45 degree entry with all corners closed as shown in Figure 4-6.
c. Parallel Flow Branches: See Figure 4-5.
d. Space duct joints to avoid cutting them for branch take offs and outlet collars.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts: 2-inch wg.
2. Return Ducts (Negative Pressure): 1-inch wg.
3. Exhaust Ducts (Negative Pressure): 1-inch wg.

B. All ducts shall be galvanized steel:

3.2 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.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections. Secure fittings with screws. Install screws at intervals of 10 inches, with a minimum of (3) screws per fitting. Seal all joints and seams.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Protect duct interiors with sheet metal or plastic sheet covers from moisture, construction debris and dust, and other foreign materials until system is energized. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines," Intermediate Level.

L. Intermediate duct reinforcement to be same as duct material.

M. Do not exceed 45 degrees for easement transition angle.

N. Insulation: Where Drawings and Specifications require ducts to be insulated, make provisions for neat insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. Metal collar equivalent in depth to insulation thickness and of suitable size to which insulation may be finished used for this purpose shall be attached to the duct. Linings in air ducts shall meet the Erosion Test Method described in UL Publication no. 181.

3.3 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Structural-steel fasteners appropriate for construction materials to which hangers are being attached.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

G. Support round ducts from building structure with galvanized steel hangers as recommended in SMACNA manual. Secure hangers to masonry portion of building by means of inserts or other acceptable anchors.

3.4 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.

3.5 FIELD QUALITY CONTROL

A. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

3.6 AIR TEST AND BALANCE

A. Prepare the system for tests as specified in Section 230593 and correct deficiencies found by the Test and Balance firm.

B. Duct dimensions shown on Drawings indicate inside clear dimensions. Make allowances for duct requiring internal sound lining, or insulation to provide "inside clear"(IC) dimensions.

C. In addition to the requirements above, add supplemental bracing as necessary to prevent sagging and drumming, and/or vibration.

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 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Fire dampers.
3. **Combination fire and smoke Dampers.**
4. Turning vanes.
5. Flexible connectors.
6. Flexible ducts.
7. Duct mounted Access Doors.
8. Duct accessory hardware.

1.3 SUBMITTALS

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

B. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

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 AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers:

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. Cesco Products.
d. Flexmaster U.S.A., Inc.
e. Greenheck Fan Corporation.
f. McGill AirFlow LLC.
g. METALAIRE, Inc.
h. Nailor Industries Inc.
i. Penn Ventilation.
j. Ruskin Company.
k. Vent Products Company, Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

a. Hat-shaped, galvanized steel channels, 0.064-inch minimum thickness.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized steel, 0.064-inch thick.

6. Blade Axles: Galvanized steel or Stainless steel.
7. Bearings:

a. Oil-impregnated bronze, Molded synthetic or Stainless steel sleeve.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 FIRE DAMPERS

A. Available Manufacturers:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
8. Penn Ventilation Company.
9. Pottorff Inc.
10. Prefco; Perfect Air Control, Inc.
11. Ruskin Company.
12. Vent Products Company, Inc.
13. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.4 COMBINATION FIRE AND SMOKE DAMPERS

A. Available Manufacturers:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff Inc.
6. Ruskin Company.

B. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

G. Smoke Detector: Coordinate with Fire alarm for manufacturer of Smoke detector.

H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized steel blade connectors.

I. Leakage: Class I.

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.

L. Damper Motors: two-position action.

M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

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. **Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.**
3. **Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.**
4. **Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.**
5. **Electrical Connection: 115 V, single phase, 60 Hz.**

N. Accessories:

1. **Auxiliary switches for position indication.**
2. **Momentary test switch and Test and reset switches, damper mounted.**

2.5 FLEXIBLE DUCTS

A. Manufacturers:

1. Flexmaster U.S.A., Inc.
2. Hart and Cooley, Inc.
3. JP Lampborn.
4. McGill AirFlow LLC.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.

C. Flexible Duct Connectors:

1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

2.6 TURNING VANES

A. Manufacturers:

1. Aerodyne, Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set for ducts over 36 inches; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall.

E. Install turning vanes in all square and rectangular elbows.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Available Manufacturers:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.
8. Ventfabrics, Inc.
9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

    a. Double wall, rectangular.
    b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    c. Vision panel.
    d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

    a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 24 gage thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.9 DUCT ACCESSORY HARDWARE

A. 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.

C. 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.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install flexible connectors to connect ducts to equipment.

G. Connect flexible ducts to metal ducts with draw bands and provide maximum 6ft length of flexible ducts.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233713 - 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 SUMMARY

A. This Section includes diffusers, registers, and grilles for all HVAC systems.

1.3 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

A. Product Data: For each model indicated, include the following:

1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, color and mounting details. Include materials and methods of assembly.
2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Anemostat.
2. Hart & Coolie.
3. Krueger.
4. METALAIRE, Inc.
5. Nailor Industries.
6. Price Industries.
7. Titus.

2.2 SOURCE QUALITY CONTROL

A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Contracting Officer for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 238129 – VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: VRF HVAC systems.

1. Indoor, concealed, ceiling-mounted units for ducting.
2. Outdoor, air-source heat pump units.
3. Outdoor, air-source heat recovery units.
4. Heat recovery control units (HRCUs).
5. System controls.
6. System refrigerant and oil.
7. System condensates drain piping.
8. System refrigerant piping.
9. Fastener systems.
10. Pipe stands.
11. Outdoor equipment stands.
12. Miscellaneous support materials.
13. Piping and tubing insulation.

B. Section includes factory engineered variable refrigerant flow (VRF) system consisting of indoor air conditioning units (heating & cooling), air-source heat pumps/condensing units, refrigerant flow control devices (branch selector, branch controllers or heat recovery units) and all related controls and accessories noted herein and on contract drawings.

C. The system shall be an air source heat pump system designed for simultaneous heating and cooling (heat recovery) operation. The plant consisting of air source condensing units/heat pumps may alternatively be referred to as 'outdoor units' in this specification.

D. Proposed systems shall take into account project site altitude and fluid operating temperatures when designing their systems.

1.2 DEFINITIONS

A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.

B. Heat-Pump System Operation: System capable of operation with all zones in either heating or cooling, but not with simultaneous heating and cooling zones that transfer heat between zones.

C. Heat Recovery System Operation: System capable of operation with simultaneous heating and cooling zones that transfer heat between zones.

D. HRCU: Heat Recovery Control Unit. HRCUs are used in heat recovery VRF HVAC systems to manage and control refrigerant between indoor units to provide simultaneous heating and

cooling zones. "Heat Recovery Control Unit" is the term used by ASHRAE for what different manufacturers term as branch circuit controller, branch selector box, changeover box, flow selector unit, mode change unit, and other such terms.

E. 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.

F. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

G. Three-Pipe System Design: One high pressure refrigerant vapor line, one low pressure refrigerant vapor line, and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One liquid line and refrigerant vapor line connect HRCUs to associated indoor units.

H. Two-Pipe System Design: One refrigerant vapor line and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One refrigerant liquid line and refrigerant vapor line connect HRCUs to associated indoor units. HRCUs used in two pipe systems act as an intermediate heat exchanger and include diverting valves and gas/liquid separators to move high and low pressure refrigerant between indoor units.

I. VRF: Variable refrigerant flow.

1.3 SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Provide engineered system flow diagrams similar to basis of design system shown on contract documents. The drawing to show pipe sizing, lengths, fittings, necessary refrigerant charge and control wiring for the complete system.
2. These shop drawings to include heating-cooling capacities of indoor and outdoor systems, system diversity, electrical requirements, sound data and related.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection. Piping size in accordance with manufacturer’s recommendation. Provide certificate of approval from manufacturer
4. Include refrigerant piping floor plan layouts in addition to the flow diagrams. These floor plans to show pipe routing, refrigerant control device locations and points of connection to indoor and outdoor units.

5. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units and for HRCUs.
6. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.

7. Indicate location and type of service access.

C. Seismic Qualification Data: Certificates, for equipment, accessories, and components, from manufacturer.

D. Operation and Maintenance Data: For VRF HVAC systems to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

B. All wiring to be in accordance with the National Electric Code (NEC).

C. The system shall be produced in an ISO 9001 and ISO 14001 registered facility. The system shall be factory tested for safety and function.

D. System shall comply with UL 1995 Heating and Cooling Equipment Standard for Safety and bare Electrical Testing Laboratories (ETL) label.

E. The outdoor units shall be fully charged HFC type refrigerant. Systems using HCFC refrigerants are not allowed. Additional charge (field installed) may be required for a fully charged system.

F. Installer's qualifications: They system shall be installed by a factory trained and certified or licensed contractor. Training and certification shall be by the VRV manufacturer or authorized manufacturers' agent. Untrained contractors who wish to bid this project may contact the local authorized manufacturers' service agent to arrange training prior to bid day.

G. Designer's qualifications: Proposed systems shall be designed or reviewed by manufacturer or manufacturers authorized service agent.

H. Startup service shall be by factory-authorized agent. Startup personnel shall perform all troubleshooting, adjusting and repair of system as required for a completely functional system.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in a clean and dry place.

B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.

C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.

D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.

1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.

2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remover coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.

E. Replace installed products damaged during construction.

1.6 WARRANTY

A. Manufacturers' standard warranty but no less than 36-months from substantial completion. Installing contractor must adhere to manufactures' design, installation and startup requirements to achieve warranty.

B. Compressors shall have manufacturers' limited 5-year warranty on compressors. Compressor warranty shall be limited to manufacturing defects only.

PART 2 - PRODUCTS

2.1 VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   1. LG Electronics.

B. Source Limitations: Obtain products from single source from single manufacturer including, but not limited to, the following indoor and outdoor units, including accessories.

   1. Controls and software.
   2. HRCUs.
   3. Refrigerant isolation valves.
   4. Specialty refrigerant pipe and pipe fittings.

2.2 SYSTEM DESCRIPTION

A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, HRCUs, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.

   1. Two-pipe or three-pipe system design.
   2. System(s) operation, air-conditioning or heat recovery as indicated on Drawings.
   3. Each system with one refrigerant circuit shared by all indoor units connected to system.

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. AHRI Compliance: System and equipment performance certified according to AHRI 1230 and products listed in AHRI directory.

D. ASHRAE Compliance:

1. ASHRAE 15: For safety code for mechanical refrigeration.
2. ASHRAE 62.1: For indoor air quality.
3. ASHRAE 135: For control network protocol with remote communication.
4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.

E. UL Compliance: Comply with UL 1995.

2.3 PERFORMANCE REQUIREMENTS

A. System Design and Installation Requirements:

1. Design and install systems indicated according to manufacturer's recommendations and written instructions.
2. Where manufacturer's requirements differ from requirements indicated, contact Contracting Officer for direction. The most stringent requirements should apply unless otherwise directed in writing by Contracting Officer.

B. System Adaptability to Future Changes: Arrange and size system refrigerant piping to accommodate future changes to system without having to resize and replace existing refrigerant piping.

1. Each branch circuit shall accommodate addition of one indoor unit(s) with unit capacity equal to average indoor unit connected to the branch circuit.

C. Isolation of Equipment: Provide isolation valves to isolate each HRCU, indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.

2.4 INDOOR, CONCEALED, CEILING-MOUNTED UNITS FOR DUCTING

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:

1. Material: Galvanized steel.
2. Cabinet shall be constructed with flame and heat resistant, sound absorbing thermal insulation. Access panels for electrical and control devices shall be provided and clearly marked.
3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
4. Cabinet shall be designed for horizontal discharge and horizontal or vertical inlet of airflow.
5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material with threaded NPT.

E. Fan and Motor Assembly:

1. Fan(s):

   a. Direct-drive arrangement.
   b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
   c. Fabricated from non-ferrous components or ferrous components with corrosion-resistant finish.
   d. Wheels statically and dynamically balanced.

2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
2. Filter Efficiency: ASHRAE 52.2, MERV 8. Media: Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.

G. Unit Controls:

1. Enclosure: Metal, suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors:

a. Unit inlet air temperature.
b. Unit outlet air temperature.
c. Coil entering refrigerant temperature.
d. Coil leaving refrigerant temperature.

4. Features and Functions:

a. Self-diagnostics.
b. Time delay.
c. Auto-restart.
d. External static pressure control.
e. Auto operation mode.
f. Manual operation mode.
g. Filter service notification.
h. Power consumption display.
i. Drain assembly high water level safety shutdown and notification.
j. Run test switch.

5. Communication: Network communication with other indoor and outdoor units.
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

H. Unit Electrical:

1. Enclosure: Metal, suitable for indoor locations.
2. Field Connection: Single point connection to power unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways.

2.5 OUTDOOR, AIR-SOURCE HEAT-PUMP UNITS

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
3. All units installed shall be from the same product development generation.

B. Cabinet:

1. Galvanized steel and coated with a corrosion-resistant finish.

a. Coating with documented salt spray test performance of 1000 hours according ASTM B117 surface scratch test (SST) procedure.

2. Mounting: Manufacturer-designed provisions for field installation.
3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Compressor and Motor Assembly:

1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
2. Protection: Integral protection against the following:

a. High refrigerant pressure.
b. Low oil level.
c. High oil temperature.
d. Thermal and overload.
e. Voltage fluctuations.
f. Phase failure and phase reversal.
g. Short cycling.

3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
4. Vibration Control: Integral isolation to dampen vibration transmission.
5. Oil management system to ensure safe and proper lubrication over entire operating range.
6. Crankcase heaters with integral control to maintain safe operating temperature.
7. Fusible plug.

D. Condenser Coil Assembly:

1. Plate Fin Coils:

a. Casing: Aluminum, galvanized, or stainless steel.
b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
c. Tubes: Copper, of diameter and thickness required by performance.

2. Coating: Corrosion resistant.
3. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

E. Condenser Fan and Motor Assembly:

1. Fan(s): Propeller type.

a. Direct-drive arrangement.
b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
c. Statically and dynamically balanced.

2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
6. Vibration Control: Integral isolation to dampen vibration transmission.

F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.

G. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors:

   a. Refrigerant suction temperature.
   b. Refrigerant discharge temperature.
   c. Outdoor air temperature.
   d. Refrigerant high pressure.
   e. Refrigerant low pressure.
   f. Oil level.

4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, power consumption display, run test switch.
5. Communication: Network communication with indoor units and other outdoor unit(s).
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

H. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

I. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.

3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.6 OUTDOOR, AIR-SOURCE HEAT RECOVERY / HEAT PUMP UNITS

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Specially designed for use in systems with simultaneous heating and cooling.
2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
3. All units installed shall be from the same product development generation.

B. The outdoor unit shall be capable of operating at site conditions including ambient winter and summer temperatures listed and project altitude. System shall be capable of operating over the following ranges at a minimum:
1. Heating only: -22 degrees F to 75 degrees F with no de-rate of capacity listed in schedule.
2. Cooling only: 22 degrees F to 110 degrees F
3. Simultaneous heating & cooling: 22 degrees F to 60 degrees F.
4. System diversity shall not exceed values listed on drawings.

C. Cabinet:

1. Galvanized steel and coated with a corrosion-resistant finish.

2. Mounting: Manufacturer-designed provisions for field installation.
3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

D. Compressor and Motor Assembly:

1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to **15** percent of rated capacity.
2. Protection: Integral protection against the following:

a. High refrigerant pressure.
b. Low oil level.
c. High oil temperature.
d. Thermal and overload.
e. Voltage fluctuations.
f. Phase failure and phase reversal.
g. Short cycling.

3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
4. Vibration Control: Integral isolation to dampen vibration transmission.
5. Oil management system to ensure safe and proper lubrication over entire operating range.
6. Crankcase heaters with integral control to maintain safe operating temperature.

7. Fusible plug.

E. Condenser Coil Assembly:

1. Plate Fin Coils:

a. Casing: Aluminum, galvanized, or stainless steel.
b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
c. Tubes: Copper, of diameter and thickness required by performance.

2. Coating: Corrosion resistant.
3. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.

F. Condenser Fan and Motor Assembly:

1. Fan(s): Propeller type.

a. Direct-drive arrangement.
b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
c. Statically and dynamically balanced.

2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
5. Speed Settings and Control: Variable speed with a speed range of least **75** percent.
6. Vibration Control: Integral isolation to dampen vibration transmission.

G. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.

H. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
2. Factory-Installed Controller: Configurable digital control.

3. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, power consumption display, run test switch.
4. Communication: Network communication with indoor units and other outdoor unit(s).
5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

7. Control Wiring: Control wiring between indoor and outdoor units shall be via daisy chain configuration of 2-conductor wire similar to RS485 communication wire. Coordinate with installing Contractor whether wire is shielded or non-shielded.

I. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
2. Electrical System: Control voltage and phase shall be as shown on contract drawings. Outdoor unit shall be capable of operating within + or – 10% of listed nameplate voltage without damage to unit. The electrical system shall include transformers for internal control devices.
3. Field Connection: Single point connection to power entire unit and integral controls.
4. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.

J. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.7 HEAT RECOVERY CONTROL UNITS (HRCUs)

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Especially designed for use in systems with simultaneous heating and cooling.
2. Systems shall consist of one unit, or multiple unit that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.

B. Cabinet:

1. Galvanized-steel construction.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. If required by manufacturer's design has a drain pain on heat recovery control units, then provide unit casing and piping with insulation to not require condensate drain.

D. Refrigeration Assemblies and Specialties:

1. Specially designed by manufacturer for type of VRF HVAC system being installed, either two or three pipe.

2. Each refrigerant branch circuit shall have refrigerant control valve(s) to control refrigerant flow.
3. Spares: Each heat recovery control unit shall include at least **one** branch circuit port(s) for future use.
4. Each system piping connection upstream of heat recovery unit shall be fitted with an isolation valve to allow for service to any heat recovery control unit in the system without interrupting operation of the system.
5. Each branch circuit connection shall be fitted with an isolation valve and capped service port to allow for service to any individual branch circuit without interrupting operation of the system.

    a. If not available as an integral part of the heat recovery control unit, isolation valves shall be field installed adjacent to the unit pipe connection.

E. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Features and Functions: Self-diagnostics, fuse protection.
4. Communication: Network communication with indoor units and outdoor unit(s).
5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

F. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

G. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.8 CONTROL SYSTEM

A. Central control system: A factory furnished control system shall be provided by VRV manufacturer. Control system shall include central controller, outdoor unit control and

individual indoor unit control integration and shall also include zone temperature sensors or wall mounted controller with integral temperature sensor. The integrated VRF control system shall communicate to building EMCS/FMS thru BACnet open protocol communication. Central controller shall be web accessible. Central controller shall include keypad and LCD or similar display for system settings and system diagnostics. Device shall allow web-based interface thru owner provided IP address.

B. Plant control system: Each plant controller shall have battery backup and all software required to operate the system shall reside at this level. If loss of central controller, EMCS/FMS or workstation occurs, the system shall be capable of operating on own based on latest input values. Control wiring from plant controller to indoor unit/refrigeration control devices shall be via daisy chain 2-conductor system or similar. The plant controller shall include LCD or similar display revealing operating status, operating mode, alarms and related points. The complete control system shall integrate to a central hub and tie to operator workstation and JCI campus UI system. Wiring back to central hub shall be CAT-5e or similar.

C. Zone level controls: Individual indoor units shall be equipped with wired (wireless devices not allowed) low voltage temperature sensor or wall mounted controller with integral temperature sensor. Sensor shall be integrated with complete VRF control system. Sensor shall be wall mounted type and individually addressable through central system. Zone temperature sensor/controller shall include following characteristics

1. On/off control.
2. Temperature adjustment (set point).
3. Room temperature.
4. Mode selection (heating/cooling).
5. Fans speed adjustment.
6. Relative humidity reading.
7. Integral occupancy sensor.
8. Occupied/unoccupied temperature set points.
9. Control of discharge vane settings (cassette type units only).
10. BACNET capable.

2.9 SYSTEM REFRIGERANT AND OIL

A. Refrigerant:

1. R-32 refrigerant.

B. Oil:

1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

2.10 VRF SYSTEM CONDENSATE DRAIN PIPING

A. Copper Tubing:

1. Drawn-Temper Tubing: According to ASTM B88, Type M or Type DWV according to ASTM B306.
2. Wrought-Copper Fittings: ASME B16.22.
3. Wrought-Copper Unions: ASME B16.22.
4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux according to ASTM B813.

2.11 VRF SYSTEM REFRIGERANT PIPING

A. Comply with requirements in Section 232300 "Refrigerant Piping" for system piping requirements.

B. Refrigerant Piping:

1. Copper Tube: ASTM B280, Type ACR.
2. Wrought-Copper Fittings: ASME B16.22.
3. Brazing Filler Metals: AWS A5.8/A5.8M.

C. Refrigerant Tubing Kits:

1. Furnished by VRF HVAC system manufacturer.
2. Factory-rolled and -bundled, soft-copper tubing with tubing termination fittings at each end.
3. Standard one-piece length for connecting to indoor units.
4. Pre-insulated with flexible elastomeric insulation of thickness to comply with governing energy code and sufficient to eliminate condensation.
5. Factory Charge: Dehydrated air or nitrogen.

D. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.

E. Refrigerant Isolation Ball Valves:

1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
3. Valve Connections: Flare or sweat depending on size.

2.12 MISCELLANEOUS SUPPORT MATERIALS

A. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.

B. Threaded Rods: Continuously threaded. Zinc-plated steel or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar material as rods.

2.13 PIPING AND TUBING INSULATION

A. Comply with requirements in Section 230700 "Plumbing and HVAC Insulation" for system piping insulation requirements.

B. Condensate Drain Piping and Tubing Insulation and Jacket Requirements:

1. Flexible Elastomeric Insulation:

a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
b. Indoors: 1/2 inch thick.
c. Outdoors: 1 inch thick.

2. Field-Applied Jacket:

a. Outdoors, Exposed to View: Stainless steel jacket, Smooth or Stucco-embossed.

C. Refrigerant Tubing Insulation and Jacket Requirements:

1. Flexible Elastomeric Insulation:

a. Closed-cell, sponge- or expanded-rubber materials, complying with ASTM C534, Type I for tubular materials.
b. Indoors: 1 inch thick.
c. Outdoors: 1 inch thick.

2. Field-Applied Jacket:

a. Outdoors, Exposed to View: Stainless steel jacket, Smooth or Stucco-embossed.

D. Flexible Elastomeric Insulation Adhesive: Comply with MIL-A-24179A, Type II, Class I.

E. Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

2.14 SYSTEM CONTROL CABLE

A. Cable Rating: Listed and labeled for application according to NFPA 70.

1. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

a. Flame Travel Distance: 60 inches or less.
b. Peak Optical Smoke Density: 0.5 or less.

c. Average Optical Smoke Density: 0.15 or less.

2. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
3. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

B. Low-Voltage Control Cabling:

1. Paired Cable: NFPA 70, Type CMG.

a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
b. PVC insulation.
c. Braided or foil shielded.
d. PVC jacket.
e. Flame Resistance: Comply with UL 1685.

2. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
b. PVC insulation.
c. Braided or foil shielded.
d. PVC jacket.
e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
f. Flame Resistance: Comply with NFPA 262.

C. TIA-485A Network Cabling:

1. Standard Cable: NFPA 70, Type CMG.

a. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
b. PVC insulation.
c. Unshielded.
d. PVC jacket.
e. Flame Resistance: Comply with UL 1685.

2. Plenum-Rated Cable: NFPA 70, Type CMP.

a. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
b. Fluorinated ethylene propylene insulation.
c. Unshielded.
d. Fluorinated ethylene propylene jacket.
e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
f. Flame Resistance: NFPA 262.

D. Ethernet Network Cabling: TIA-568-C.2 Category 6 cable with RJ-45 connectors.

1. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of category cable indicated.
2. Conductors: 100-ohm, 23 AWG solid copper.
3. Shielding: Shielded twisted pairs (FTP).
4. Cable Rating: By application.
5. Jacket: White thermoplastic.

E. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for cable raceways.

2.15 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect factory-assembled equipment.

B. Equipment will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports for historical record. Submit reports only if requested.

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 products before installation. Reject products that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.

D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.

E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.

F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.

G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VRF SYSTEM EQUIPMENT INSTALLATION, GENERAL

A. Clearance:

1. Maintain manufacturer's recommended clearances for service and maintenance.
2. Maintain clearances required by governing code.

B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.

C. Equipment Restraint Installation: Install equipment with seismic-restraint device. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

3.3 INSTALLATION OF INDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch.

C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.

D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.

E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.

F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.

G. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch.

H. For wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.

I. Attachment: Install hardware for proper attachment to supported equipment.

J. On ducted units, provide flexible connection on inlet and outlet connections as noted on drawings.

K. Install refrigerant piping in accordance with VRF manufacturers written instructions. Route piping to maintain service clearances of unit.

L. Install condensate drain piping as noted on drawings. Provide cleanouts as noted.

M. Connect refrigerant piping to refrigerant control/distribution devices in accordance to manufacturers written instructions. Provide isolation valves on upstream piping (HRCU side of device).

N. Locate refrigerant control devices above accessible ceilings or provide access hatch for service.

O. Connect power and control wiring in strict accordance to manufacturers written instructions. Refer to Division 26 for specific requirement on line and low voltage wiring and conduit installation.

3.4 INSTALLATION OF OUTDOOR UNITS

A. Install units to be level and plumb while providing a neat and finished appearance.

B. Install outdoor units on support structures indicated on Drawings.

C. Roof-Mounted Installations: Install outdoor units on equipment supports. Anchor units to supports with removable, stainless steel fasteners.

D. Provide isolation valves on refrigerant suction, hot gas and liquid lines for individual servings of outdoor ACCU's. Provide approved flexible refrigerant pipe connection on unit. Install unit level and plumb.

E. Furnish and install refrigerant piping in strict accordance with VRF manufacturers' installation guidelines and shop drawings. Refer to Division 23 "Refrigeration Piping" for additional information regarding refrigeration piping. Install piping to allow service of equipment.

F. Contractor shall provide additional refrigerant charge to completely charge VRF system including refrigerant lines and indoor units. Adhere to VRF manufacturer for final refrigerant charge required on the system. Use only refrigerants specified by VRF manufacturer.

G. Connect power and control wiring in strict accordance to manufacturers written instructions. Refer to Division 26 for specific requirement on line and low voltage wiring and conduit installation.

3.5 GENERAL REQUIREMENTS FOR REFRIGERANT PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping and tubing to permit valve servicing.

F. Install piping and tubing at indicated slopes.

G. Install piping and tubing free of sags.

H. Install fittings for changes in direction and branch connections.

I. Install piping and tubing to allow application of insulation.

J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.

K. Install escutcheons and sleeves for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for Plumbing and HVAC."

3.6 INSTALLATION OF SYSTEM CONDENSATE DRAIN PIPING

A. General Requirements for Drain Piping and Tubing:

1. Install a union in piping at each threaded unit connection.
2. Install an adjustable stainless steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:

    a. Details indicated on Drawings.
    b. Manufacturer's requirements.
    c. Governing codes.
    d. In the absence of requirements, comply with requirements of ASHRAE handbooks.

4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

B. Gravity Drains:

1. Slope piping from unit connection toward drain termination at a constant slope of not less than one percent.

C. Pumped Drains:

1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

D. Where installing piping and tubing adjacent to equipment, allow space for service and maintenance.

3.7 INSTALLATION OF REFRIGERANT PIPING

A. Refrigerant Tubing Kits:

1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
2. Support tubing using hangers and supports indicated at intervals not to exceed 5 feet. Minimum rod size, 1/4 inch.
3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.

B. Install refrigerant piping according to ASHRAE 15 and governing codes.

C. Select system components with pressure rating equal to or greater than system operating pressure.

D. Install piping as short and direct as possible, with a minimum number of joints and fittings.

E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection.

F. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.

G. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:

1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps to entrain oil in vertical runs.
4. Liquid lines may be installed level.

H. When brazing, remove or protect components that could be damaged by heat.

I. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.

J. Joint Construction:

1. Ream ends of tubes and remove burrs.
2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
3. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

    a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.

b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

3.8 INSTALLATION OF METAL HANGERS AND SUPPORTS

A. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

3.9 INSTALLATION OF PIPING AND TUBING INSULATION

A. Comply with requirements in Section 230700 “Plumbing and HVAC Insulation” for pipe and tubing insulation.

3.10 INSTALLATION OF DUCT, ACCESSORIES, AND AIR OUTLETS

A. Where installing ductwork adjacent to equipment, allow space for service and maintenance.

B. Comply with requirements for metal ducts specified in Section 233113 "Metal Ducts."

C. Comply with requirements for air duct accessories specified in Section 233300 "Air Duct Accessories."

3.11 ELECTRICAL CONNECTIONS

A. Comply with requirements indicated on Drawings and in applicable Division 26 Sections.

B. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.

C. Comply with requirements in Division 26 for electrical wiring connections and Grounding connections.

3.12 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

3.13 IDENTIFICATION

A. Identify system equipment, piping, tubing, and valves. Comply with requirements for identification specified in Section 230553 "Identification for Plumbing and HVAC Piping and Equipment."

3.14 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.

3.15 CONTROLS

A. Install controls and wiring in accordance with VRF manufactures installation requirements. Coordinate control installation with Temperature Controls Contractor and Div 26. Arrange for required AC power required for individually controller with Division 26. Coordinate provision of conduit required for controls with Division 26.

STARTUP SERVICE

B. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.

1. Service representative shall be a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
2. Complete startup service of each separate system.
3. Complete system startup service according to manufacturer's written instructions.

C. Startup checks shall include, but not be limited to, the following:

1. Check control communications of equipment and each operating component in system(s).
2. Check each indoor unit's response to demand for cooling and heating.
3. Check each indoor unit's response to changes in airflow settings.
4. Check each indoor unit**,** HRCU, and outdoor unit for proper condensate removal.
5. Check sound levels of each indoor and outdoor unit.

D. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.

1. Installer shall correct deficiencies found during startup service for reverification.

E. System Operation Report:

1. After completion of startup service, manufacturer shall issue a report for each separate system.
2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.

3.16 DEMONSTRATION

A. Engage a VRF HVAC system manufacturer's factory-authorized service representative to train Government's maintenance personnel to adjust, operate, and maintain entire system.

B. Schedule and Duration:

1. Schedule training with Government at least 20 business days before first training session.
2. Training shall occur before Government occupancy.
3. Training shall be held at mutually agreed date and time during normal business hours.
4. Each training day shall not exceed eight hours of training. Daily training schedule shall allow time for one-hour lunch period and 15-minute break after every two hours of training.
5. Perform not less than eight total hours of training.

C. Instructor:

1. Instructor shall be factory trained and certified by VRF HVAC system manufacturer with current training on the system(s), equipment, and controls that are installed.

D. See Section 017900 for additional owner training requirements.

E. Acceptance: Obtain Government written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION 238129

SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. cd: Candela, the SI fundamental unit of luminous intensity.
17. CO/ALR: Copper-aluminum, revised.
18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).

28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.
30. EMF: Electromotive force.
31. EMI: Electromagnetic interference.
32. EPM: Electrical preventive maintenance.
33. EPS: Emergency power supply.
34. EPSS: Emergency power supply system.
35. ESS: Energy storage system.
36. EV: Electric vehicle.
37. EVPE: Electric vehicle power export equipment.
38. EVSE: Electric vehicle supply equipment.
39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
40. FLC: Full-load current.
41. ft: Foot.
42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
43. GEC: Grounding electrode conductor.
44. GFCI: Ground-fault circuit interrupter.
45. GFPE: Ground-fault protection of equipment.
46. GND: Ground.
47. HACR: Heating, air conditioning, and refrigeration.
48. HDPE: High-density polyethylene.
49. HID: High-intensity discharge.
50. HP or hp: Horsepower.
51. HVAC: Heating, ventilating, and air conditioning.
52. Hz: Hertz.
53. IBT: Intersystem bonding termination.
54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
56. IR: Infrared.
57. IS: Intrinsically safe.
58. IT&R: Inspecting, testing, and repair.
59. ITE: Information technology equipment.
60. kAIC: Kiloampere interrupting capacity.
61. kcmil or MCM: One thousand circular mils.
62. kV: Kilovolt.
63. kVA: Kilovolt-ampere.
64. kVAr or kVAR: Kilovolt-ampere reactive.
65. kW: Kilowatt.
66. kWh: Kilowatt-hour.
67. LAN: Local area network.
68. lb: Pound (weight).
69. lbf: Pound (force).
70. LCD: Liquid-crystal display.

71. LCDI: Leakage-current detector-interrupter.
72. LED: Light-emitting diode.
73. Li-ion: Lithium-ion.
74. lm: Lumen, the SI derived unit of luminous flux.
75. LNG: Liquefied natural gas.
76. LP-Gas: Liquefied petroleum gas.
77. LRC: Locked-rotor current.
78. LV: Low voltage.
79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
80. m: Meter.
81. MCC: Motor-control center.
82. MDC: Modular data center.
83. MG set: Motor-generator set.
84. MIDI: Musical instrument digital interface.
85. MLO: Main lugs only.
86. MV: Medium voltage.
87. MVA: Megavolt-ampere.
88. mW: Milliwatt.
89. MW: Megawatt.
90. MWh: Megawatt-hour.
91. NC: Normally closed.
92. Ni-Cd: Nickel-cadmium.
93. Ni-MH: Nickel-metal hydride.
94. NIU: Network interface unit.
95. NO: Normally open.
96. NPT: National (American) standard pipe taper.
97. OCPD: Overcurrent protective device.
98. ONT: Optical network terminal.
99. PC: Personal computer.
100. PCS: Power conversion system.
101. PCU: Power-conditioning unit.
102. PF or pf: Power factor.
103. PHEV: Plug-in hybrid electric vehicle.
104. PLC: Programmable logic controller.
105. PLFA: Power-limited fire alarm.
106. PoE: Power over Ethernet.
107. PV: Photovoltaic.
108. PVC: Polyvinyl chloride.
109. pW: Picowatt.
110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
111. RMS or rms: Root-mean-square.
112. RPM or rpm: Revolutions per minute.
113. SCADA: Supervisory control and data acquisition.
114. SCR: Silicon-controlled rectifier.
115. SPD: Surge protective device.
116. sq.: Square.
117. SWD: Switching duty.
118. TCP/IP: Transmission control protocol/Internet protocol.
119. TEFC: Totally enclosed fan-cooled.

120. TR: Tamper resistant.
121. TVSS: Transient voltage surge suppressor.
122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
123. UL CCN: UL Category Control Number.
124. UPS: Uninterruptible power supply.
125. USB: Universal serial bus.
126. UV: Ultraviolet.
127. V: Volt, unit of electromotive force.
128. V(ac): Volt, alternating current.
129. V(dc): Volt, direct current.
130. VA: Volt-ampere, unit of complex electrical power.
131. VAR: Volt-ampere reactive, unit of reactive electrical power.
132. VFC: Variable-frequency controller.
133. VOM: Volt-ohm-multimeter.
134. VPN: Virtual private network.
135. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
136. W: Watt, unit of real electrical power.
137. Wh: Watt-hour, unit of electrical energy usage.
138. WPT: Wireless power transfer.
139. WPTE: Wireless power transfer equipment.
140. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit (thin wall).
7. EPEC-A: Type A electrical HDPE underground conduit.
8. EPEC-B: Type B electrical HDPE underground conduit.
9. ERMC: Electrical rigid metal conduit.
10. ERMC-A: Aluminum electrical rigid metal conduit.
11. ERMC-S: Steel electrical rigid metal conduit.
12. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
13. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
14. ERMC-SS: Stainless steel electrical rigid metal conduit.
15. FMC: Flexible metal conduit.
16. FMC-A: Aluminum flexible metal conduit.
17. FMC-S: Steel flexible metal conduit.
18. FMT: Steel flexible metallic tubing.
19. FNMC: Flexible nonmetallic conduit. See "LFNC."
20. HDPE: HDPE underground conduit (thick wall).
21. HDPE-40: Schedule 40 HDPE underground conduit.
22. HDPE-80: Schedule 80 HDPE underground conduit.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.

26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
37. RGS: See ERMC-S-G.
38. RMC: See ERMC.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.

25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.

72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:

1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
4. SEOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
12. SJOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.

19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
24. STOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."

    a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.

2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.

9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

   a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
   b. Concrete Box: A box intended for use in poured concrete.
   c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
   d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
   e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
   f. Device Box: A box with provisions for mounting a wiring device directly to the box.
   g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
   h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
   i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
   j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
   k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
   l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
   m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
   n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
   o. Raised-Floor Box: A floor box intended for use in raised floors.
   p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.

q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.
12. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.

    a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.

13. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
14. Jacket: A continuous nonmetallic outer covering for conductors or cables.
15. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
16. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
17. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
18. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.

19. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
20. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
21. Sheath: A continuous metallic covering for conductors or cables.
22. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
23. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
    c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
    d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
    e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
    f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.

24. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Government or others unless permitted under the following conditions:

1. Notify Government no fewer than seven days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Government's written permission.
3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:

    a. Exercising generators.
    b. Emergency lighting.
    c. Elevators.
    d. Fire-alarm systems.
    e. Communication systems

B. Arrange to provide temporary electrical power in accordance with requirements specified in Division 01.

1.4 SEQUENCING

A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device.
2. Include the following information:

    a. Manufacturer's operating specifications.
    b. User's guides for software and hardware.
    c. Schedule of maintenance material items recommended to be stored at Project site.
    d. Detailed instructions covering operation under both normal and abnormal conditions.
    e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
    f. List of load-current and overload-relay heaters with related motor nameplate data.
    g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
    h. Manufacturer's instructions for setting field-adjustable components.
    i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
    j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.

B. Software and Firmware Operational Documentation: Provide software and firmware operational documentation, including the following:

1. Software operating and upgrade manuals.
2. Names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.
5. Testing and adjusting of panic and emergency power features.
6. For lighting controls, include the following:

    a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
    b. Operation of adjustable zone controls.

C. Software:

1. Program Software Backup: Provide username and password for approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
2. Provide to Government upgrades and unrestricted licenses for Government use for installed and backup software, including operating systems and programming tools required for operation and maintenance.

1.6 QUALIFICATIONS

A. Electrical Power Monitoring Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by manufacturer prior to starting installation.

B. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.

1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.

C. Luminaire Photometric Testing Laboratory: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" accredited under the NVLAP for Energy Efficient Lighting Products, and complying with applicable IES testing standards.

D. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing and inspecting lighting installations in accordance with IES LM-5.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Contracting Officer for resolution of conflicting requirements.

3.2 SYSTEM STARTUP

A. Commissioning Activities:

1. Section 260800 - Electrical Commissioning.

3.3 FIELD QUALITY CONTROL

A. Administrant for Low-Voltage Electrical Tests and Inspections:

1. Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

B. Administrant for Field Tests and Inspections of Lighting Installations:

1. Engage qualified lighting testing and inspecting agency to administer and perform tests and inspections.

3.4 CLOSEOUT ACTIVITIES

A. Demonstration: With assistance from factory-authorized service representatives, demonstrate to Government's maintenance and clerical personnel how to operate the following systems and equipment:

1. Lighting control devices specified in Section 260923 "Lighting Control Devices."

B. Provide video recordings of demonstrations to Government.

C. Training: With assistance from factory-authorized service representatives, train Government's maintenance personnel on the following topics:

1. Electrical power safety fundamentals refresher including arc-flash hazard safety features of electrical power distribution equipment in facility, interpreting arc-flash warning labels, selecting appropriate personal protective equipment, and understanding significance of findings documented in study report specified in Section 260573.19 "Arc-Flash Hazard Analysis."
2. How to adjust, operate, and maintain devices specified in Section 260923 "Lighting Control Devices."
3. How to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories specified in Section 262413 "Switchboards."
4. How to adjust, operate, and maintain equipment specified in Section 262913.03 "Manual and Magnetic Motor Controllers."
5. How to adjust, operate, and maintain transfer switches and related equipment, including ground-fault protection system, specified in Section 263600 "Transfer Switches."
6. How to adjust, operate, and maintain luminaires specified in Section 265619 "LED Exterior Lighting."

D. Provide video recordings of training sessions to Government.

END OF SECTION

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Aluminum building wire.
3. Metal-clad cable, Type MC.
4. Connectors and splices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cabling used for data circuits.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Aluminum building wire.
3. Metal-clad cable, Type MC.
4. Connectors and splices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alpha Wire; brand of Belden, Inc.
2. Belden Inc.
3. Cerro Wire LLC.
4. Encore Wire Corporation.
5. General Cable; Prysmian Group North America.
6. Okonite Company (The).
7. Service Wire Co.
8. Southwire Company, LLC.
9. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. 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 B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2. Comply with UL 83.
2. Type XHHW-2. Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

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. Alpha Wire; brand of Belden, Inc.
2. Belden Inc.
3. Cerro Wire LLC.
4. Encore Wire Corporation.
5. General Cable; Prysmian Group North America.
6. Okonite Company (The).
7. Southwire Company, LLC.
8. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

E. Conductor Insulation:

1. Type THHN and Type THWN-2. Comply with UL 83.
2. Type XHHW-2. Comply with UL 44.

2.3 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems; Atkore International.
2. Alpha Wire; brand of Belden, Inc.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable; Prysmian Group North America.
6. Okonite Company (The).
7. Service Wire Co.
8. Southwire Company, LLC.
9. WESCO.

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 and multicircuit with color-coded conductors.

E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2. Comply with UL 83.

H. Armor: Steel, interlocked.

2.4 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. 3M Electrical Products.
2. ABB, Electrification Business.
3. AFC Cable Systems; Atkore International.
4. Gardner Bender.
5. Hubbell Utility Solutions; Hubbell Incorporated.
6. ILSCO.
7. Ideal Industries, Inc.
8. NSi Industries LLC.
9. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
10. Service Wire Co.
11. TE Connectivity Ltd.

C. Jacketed Cable Connectors: For steel and aluminum 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 or Aluminum.
2. Type: One or Two hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors must be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway .

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway .

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway .

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits 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."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch (150 mm) of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.7 FIELD QUALITY CONTROL

A. 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.

B. Cables will be considered defective if they do not pass tests and inspections.

C. 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

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Grounding and bonding busbars.
7. Grounding (earthing) electrodes.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:

a. Plans showing locations of grounding features described in "Field Quality Control" Article, including the following:

1) Test wells.
2) Rod electrodes.
3) Grounding arrangements and connections for separately derived systems.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. UL KDER - Armored Grounding Wire:

1. Description: Single corrosion-resistant copper, aluminum, or copper-clad aluminum conductor within helically formed steel armor.
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. LS Cable & System USA; subsidiary of LS Corp.
   b. Southwire Company, LLC.
   c. Superior Essex Inc.; subsidiary of LS Corp.
   d. Viakon; brand of Conductores Monterrey S.A. de C.V.; a subsidiary of Xignux.

3. Regulatory Requirements:

   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

4. Listing Criteria:

   a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

C. UL KDSH - Protector Grounding Conductor:

1. Description: Conductors intended to be used for grounding primary protector or metallic members of cable sheath in accordance with Chapters 7 and 8 of NFPA 70.
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. Superior Essex Inc.; subsidiary of LS Corp.

3. Regulatory Requirements:

   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

4. Listing Criteria:

    a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

5. Options:

    a. Color: green.

2.2 GROUNDING AND BONDING CLAMPS

A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

    a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

    a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
    b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp :

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. ABB, Electrification Business.
    b. America Fujikura Ltd. (AFL); Fujikura Ltd.
    c. Arlington Industries, Inc.
    d. Cooper B-line; brand of Eaton, Electrical Sector.
    e. Crouse-Hinds; brand of Eaton, Electrical Sector.
    f. ERICO; brand of nVent Electrical plc.
    g. Galvan Industries, Inc.; Electrical Products Division, LLC.
    h. Greaves Corp.; Essex Products Group, Inc.
    i. Harger Lightning & Grounding; business of Harger, Inc.
    j. ILSCO.

k. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
l. Panduit Corp.
m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2. General Characteristics:

a. Two pieces with zinc-plated bolts.
b. Clamp Material: Brass, Tinned brass.
c. Listed for outdoor use.

E. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp :

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. ABB, Electrification Business.
b. America Fujikura Ltd. (AFL); Fujikura Ltd.
c. Arlington Industries, Inc.
d. Cooper B-line; brand of Eaton, Electrical Sector.
e. Crouse-Hinds; brand of Eaton, Electrical Sector.
f. ERICO; brand of nVent Electrical plc.
g. Galvan Industries, Inc.; Electrical Products Division, LLC.
h. Greaves Corp.; Essex Products Group, Inc.
i. Harger Lightning & Grounding; business of Harger, Inc.
j. ILSCO.
k. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
l. Panduit Corp.
m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2. General Characteristics:

a. Clamp Material: Brass, Tinned brass.
b. Listed for outdoor use.

F. UL KDER and KDSH - Strap-Type Pipe and Rod Grounding and Bonding Clamp :

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. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
b. Crouse-Hinds; brand of Eaton, Electrical Sector.
c. ERICO; brand of nVent Electrical plc.
d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.

e. Panduit Corp.

2. General Characteristics:

a. Clamp Material: Copper, Tinned copper.
b. Listed for outdoor use.

G. UL KDER - Beam Grounding and Bonding Clamp :

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. ABB, Electrification Business.
b. Anderson; brand of Hubbell Utility Solutions; Hubbell Incorporated.
c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
d. Panduit Corp.
e. Penn-Union Corp.; subsidiary of Nesco, Inc.

2. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.

H. UL KDER - Exothermically Welded Connection :

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. ABB, Electrification Business.
b. ALLTEC LLC.
c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
d. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
e. Crouse-Hinds; brand of Eaton, Electrical Sector.
f. ERICO; brand of nVent Electrical plc.
g. Harger Lightning & Grounding; business of Harger, Inc.

2. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Bonding Bushing :

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. ABB, Electrification Business.
b. Arlington Industries, Inc.
c. Crouse-Hinds; brand of Eaton, Electrical Sector.
d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2. General Characteristics: Threaded bushing with insulated throat.

E. UL KDER - Grounding Bushing :

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. ABB, Electrification Business.
b. Arlington Industries, Inc.
c. Crouse-Hinds; brand of Eaton, Electrical Sector.
d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.4 GROUNDING AND BONDING HUBS

A. Description: Hubs with certified grounding or bonding locknut.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Grounding and Bonding Hub :

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. ABB, Electrification Business.
b. Arlington Industries, Inc.
c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
d. Crouse-Hinds; brand of Eaton, Electrical Sector.
e. Greaves Corp.; Essex Products Group, Inc.
f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
g. Penn-Union Corp.; subsidiary of Nesco, Inc.

2. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.5 GROUNDING AND BONDING CONNECTORS

A. Source Limitations: Obtain products from single manufacturer.

B. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector :

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. ABB, Electrification Business.
b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.

D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal :

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. ABB, Electrification Business.
b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
c. Chatsworth Products, Inc.
d. Greaves Corp.; Essex Products Group, Inc.
e. ILSCO.

2. General Characteristics: Mechanical-type, copper rated for direct burial terminal with set screw.

E. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal :

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. ABB, Electrification Business.
b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
c. Harger Lightning & Grounding; business of Harger, Inc.
d. ILSCO.

2. General Characteristics: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch (16 or 25 mm) centers for two-bolt connection to busbar.

F. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal :

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. Panduit Corp.

2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.

G. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector :

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. ABB, Electrification Business.
    b. allG Fabrication; business of Advanced Lightning Technology, Ltd.
    c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    d. ILSCO.

2. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.

    a. Copper, Tinned copper, C and H shaped.

H. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector :

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. ABB, Electrification Business.
    b. allG Fabrication; business of Advanced Lightning Technology, Ltd.
    c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    d. ERICO; brand of nVent Electrical plc.
    e. Greaves Corp.; Essex Products Group, Inc.

2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.

    a. Copper, Tinned copper.

2.6 GROUNDING AND BONDING BUSBARS

A. Description: Miscellaneous grounding and bonding device that serves as common connection for multiple grounding and bonding conductors.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Equipment Room Grounding and Bonding Busbar :

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. allG Fabrication; business of Advanced Lightning Technology, Ltd.
b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
c. Chatsworth Products, Inc.
d. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
e. Cooper B-line; brand of Eaton, Electrical Sector.
f. ERICO; brand of nVent Electrical plc.
g. Harger Lightning & Grounding; business of Harger, Inc.
h. Hoffman; brand of nVent Electrical plc.
i. ILSCO.
j. Panduit Corp.

2. General Characteristics:

a. Bus: Rectangular bar of annealed copper.
b. Mounting Stand-Off Insulators: Lexan or PVC.

1) Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.

3. Options:

a. Predrilled Hole Pattern: 9/32 inch (7.14 mm) holes spaced 1-1/8 inch (28 mm) apart.
b. Mounting Hardware: Stand-off brackets that provide 2 inch (50 mm) clearance to access rear of bus. Brackets and bolts must be stainless steel.

E. UL KDER - Rack and Cabinet Bonding Busbar :

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. Chatsworth Products, Inc.
b. Cooper B-line; brand of Eaton, Electrical Sector.
c. Harger Lightning & Grounding; business of Harger, Inc.
d. Hoffman; brand of nVent Electrical plc.
e. Panduit Corp.

2. General Characteristics:

a. Bus: Rectangular bar of hard-drawn solid copper.
b. Horizontal Mounting Dimensions: Designed for mounting in 19 inch (483 mm) wide equipment racks or cabinets.
c. Vertical Mounting Dimensions: Designed for mounting in 72 inch (1827 mm) high equipment racks or cabinets.
d. Predrilled Hole Pattern: Accepts connectors for grounding and bonding conductor sizes 14 AWG to 2/0 AWG.
e. Mounting Hardware: Stainless steel or copper-plated, for attachment to rack.

2.7 GROUNDING (EARTHING) ELECTRODES

A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Rod Electrode :

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. ABB, Electrification Business.
b. allG Fabrication; business of Advanced Lightning Technology, Ltd.
c. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
d. ERICO; brand of nVent Electrical plc.

e. Galvan Industries, Inc.; Electrical Products Division, LLC.
f. Harger Lightning & Grounding; business of Harger, Inc.

2. General Characteristics: Copper-clad steel; 3/4 inch by 10 ft (19 mm by 3 m).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's 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 electrical system.

B. Inspect test results of grounding system measured at point of electrical service equipment connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF BUSBARS

A. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inch (50 mm) minimum from wall, 6 inch (150 mm) above finished floor unless otherwise indicated.
2. 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.

3.3 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.

B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.

C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch (6 mm) in diameter.

D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.

F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.

3.4 SELECTION OF CONNECTORS

A. 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.

3.5 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Consult Contracting Officer for resolution of conflicting requirements.

C. Special Techniques:

1. Conductors:

a. 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.

2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
b. Make connections with clean, bare metal at points of contact.
c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
f. 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 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 disconnect-type connection is required, use bolted clamp.

g. 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 bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where 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 bolted connector.
3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3. Electrodes:

a. Ground Rods: Drive rods until tops are 2 inch (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) Use exothermic welds for below-grade connections.

b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.

4. Grounding at Service:

a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.

5. Equipment Grounding:

a. Install insulated equipment grounding conductors with 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) Armored and 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.
d. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.6 FIELD QUALITY CONTROL

A. 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 calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before conductors are connected.

   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by 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 in accordance with IEEE Std 81.
   c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Contracting Officer promptly and include recommendations to reduce ground resistance.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to record of tests and observations. Include number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

C. Collect, assemble, and submit test and inspection reports.

1. Report measured ground resistances that exceed the following values:

a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω.
b. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 Ω.

3.7 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Government.

END OF SECTION

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

   a. Slotted support systems, hardware, and accessories.
   b. Clamps.
   c. Hangers.
   d. Sockets.
   e. Eye nuts.
   f. Fasteners.
   g. Anchors.
   h. Saddles.
   i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 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 Rating: Class 1.

2. Self-extinguishing according to ASTM D635.

2.2 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 inch (200 mm) on center in at least one surface.

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. ABB, Electrification Business.
   b. Allied Tube & Conduit; Atkore International.
   c. CADDY; brand of nVent Electrical plc.
   d. Cooper B-line; brand of Eaton, Electrical Sector.
   e. Flex-Strut Inc.
   f. G-Strut.
   g. Gripple Inc.
   h. Haydon Corporation.
   i. MIRO Industries.
   j. Metal Ties Innovation.
   k. Rocket Rack; Robroy Industries.
   l. Unistrut; Atkore International.
   m. Wesanco, Inc.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: 1-5/8 inch (41.25 mm).
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

B. Conduit and Cable Support Devices: Steel Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Cooper B-line; brand of Eaton, Electrical Sector.
2) Empire Industries, Inc.
3) Hilti, Inc.
4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

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 A325 (Grade A325M).
6. Toggle Bolts: All steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101
2. NECA NEIS 102.
3. NECA NEIS 105.
4. NECA NEIS 111.

B. Comply with requirements for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."

D. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."

E. Provide seismic controls with hangers and supports in accordance with requirements specified in "Section 260548.16 "Seismic Controls for Electrical Systems."

F. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.

G. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support 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 single-bolt conduit clamps.

H. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch (38 mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 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 ERMC may be supported by openings through structure members, in accordance with 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 must 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. To Light Steel: Sheet metal screws.

6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

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. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

END OF SECTION

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S and Type FMC-A duct raceways.
4. Type FMT duct raceways.
5. Type IMC duct raceways.
6. Type LFMC duct raceways.
7. Type PVC duct raceways and fittings.
8. Fittings for conduit, tubing, and cable.
9. Electrically conductive corrosion-resistant compounds for threaded conduit.
10. Solvent cements.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. Conduit: A structure containing one or more duct raceways.

B. Duct Raceway: A single enclosed raceway for conductors or cable.

C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S and Type FMC-A duct raceways.

4. Type FMT duct raceways.
5. Type IMC duct raceways.
6. Type LFMC duct raceways.
7. Type PVC duct raceways and fittings.
8. Fittings for conduit, tubing, and cable.
9. Electrically conductive corrosion-resistant compounds for threaded conduit.
10. Solvent cements.

PART 2 - PRODUCTS

2.1 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FJMX; including UL 797.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:

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. Allied Tube & Conduit; Atkore International.
   b. Calconduit; Atkore International.
   c. Emerson Electric Co.
   d. Picoma; Zekelman Industries.
   e. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
   f. Topaz Lighting & Electric.
   g. Western Tube; Zekelman Industries.
   h. Wheatland Tube; Zekelman Industries.

2. Material: Steel.
3. Options:

   a. Exterior Coating: Zinc.
   b. Interior Coating: Zinc.
   c. Minimum Trade Size: Metric designator 16 (trade size 1/2).
   d. Colors: As indicated on Drawings.

2.2 TYPE ERMC-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DYIX; including UL 6.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

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

   a. Allied Tube & Conduit; Atkore International.
   b. Calconduit; Atkore International.
   c. Crouse-Hinds; brand of Eaton, Electrical Sector.
   d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   e. Patriot Aluminum Products, LLC.
   f. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
   g. Topaz Lighting & Electric.
   h. Western Tube; Zekelman Industries.
   i. Wheatland Tube; Zekelman Industries.

2. Exterior Coating: Zinc.
3. Options:

   a. Interior Coating: Zinc.
   b. Minimum Trade Size: Metric designator 21 (trade size 3/4).
   c. Colors: As indicated on Drawings.

2.3 TYPE FMC-S AND TYPE FMC-A DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXUZ; including UL 1.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):

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. ABB, Electrification Business.
    b. Anaconda Sealtite; Anamet Electrical, Inc.
    c. Electri-Flex Company.
    d. International Metal Hose Co.
    e. Penn Aluminum Conduit & EMT.
    f. Topaz Lighting & Electric.

2. Material: Steel.
3. Options:

    a. Minimum Trade Size: Metric designator 16 (trade size 1/2).
    b. Colors: As indicated on Drawings.

2.4 TYPE FMT DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN ILJW; including UL Subject 1652.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL ILJW - Steel Flexible Metallic Tubing (FMT):

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. Electri-Flex Company.

b. International Metal Hose Co.
c. Liquid Tight Connector Co.
d. Southwire Company, LLC.

2. Options:

a. Minimum Trade Size: Metric designator 16 (trade size 1/2).
b. Colors: As indicated on Drawings.

2.5 TYPE IMC DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DYBY; including UL 1242.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DYBY - Steel Intermediate Metal Conduit (IMC):

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. ABB, Electrification Business.
b. Allied Tube & Conduit; Atkore International.
c. Calconduit; Atkore International.
d. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
e. Topaz Lighting & Electric.
f. Western Tube; Zekelman Industries.
g. Wheatland Tube; Zekelman Industries.

2. Options:

a. Exterior Coating: Zinc.
b. Interior Coating: Zinc.
c. Minimum Trade Size: Metric designator 21 (trade size 3/4).
d. Colors: As indicated on Drawings.

2.6 TYPE LFMC DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXHR; including UL 360.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):

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. ABB, Electrification Business.
   b. Anaconda Sealtite; Anamet Electrical, Inc.
   c. Electri-Flex Company.
   d. International Metal Hose Co.

2. Material: Steel.
3. Options:

   a. Minimum Trade Size: Metric designator 16 (trade size 1/2).
   b. Colors: As indicated on Drawings.

2.7 TYPE PVC DUCT RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DZYR; including UL 651.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and 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. ABB, Electrification Business.
   b. Calconduit; Atkore International.
   c. JM Eagle; J-M Manufacturing Co., Inc.
   d. NAPCO; Westlake Chemical Corp.
   e. Opti-Com Manufacturing Network, Inc (OMNI).
   f. Topaz Lighting & Electric.

2. Dimensional Specifications: Schedule 40.
3. Options:

   a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
   b. Markings: For use with maximum 90 deg C wire, For directional boring applications.

D. UL DZYR - Schedule 80 Rigid PVC Conduit (PVC-80) and 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. ABB, Electrification Business.
   b. Calconduit; Atkore International.
   c. JM Eagle; J-M Manufacturing Co., Inc.
   d. Opti-Com Manufacturing Network, Inc (OMNI).
   e. Topaz Lighting & Electric.

2. Dimensional Specifications: Schedule 80.
3. Options:

   a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
   b. Markings: For use with maximum 90 deg C wire, For directional boring applications.

2.8 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DWTT - Fittings for Type ERMC, Type IMC, Type PVC, Duct Raceways:

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. ABB, Electrification Business.
   b. Crouse-Hinds; brand of Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. Konkore Fittings; Atkore International.
   e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Penn Aluminum Conduit & EMT.
   g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   h. Southwire Company, LLC.
   i. Topaz Lighting & Electric.

2. Listing Criteria: UL CCN DWTT; including UL 514B.
3. Options:

   a. Material: Steel, Die cast.
   b. Coupling Method: Compression coupling, Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
   c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

D. UL FKAV - Fittings for Type EMT Duct Raceways:

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. ABB, Electrification Business.
   b. Allied Tube & Conduit; Atkore International.
   c. Calconduit; Atkore International.
   d. Crouse-Hinds; brand of Eaton, Electrical Sector.
   e. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   h. Southwire Company, LLC.
   i. Topaz Lighting & Electric.

2. Listing Criteria: UL CCN FKAV; including UL 514B.

3. Options:

a. Material: Steel, Die cast.
b. Coupling Method: Compression coupling, Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

E. UL ILNR - Fittings for Type FMC Duct Raceways:

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 Fittings Corp. (AMFICO).
b. Liquid Tight Connector Co.
c. Southwire Company, LLC.

2. Listing Criteria: UL CCN ILNR; including UL 514B.

F. UL DXAS - Fittings for Type LFMC and Type LFNC Duct Raceways:

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. Liquid Tight Connector Co.

2. Listing Criteria: UL CCN DXAS; including UL 514B.

2.9 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL FOIZ - Electrically Conductive Corrosion-Resistant Compound for Threaded Conduit:

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. ABB, Electrification Business.

2.10 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DWTT; including UL 514B.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Contracting Officer for resolution of conflicting requirements.

B. Outdoors:

1. Exposed and Subject to Severe Physical Damage: ERMC, IMC.
2. Exposed and Subject to Physical Damage: ERMC, IMC.

    a. Locations less than 2.5 m (8 ft) above finished floor.

3. Exposed and Not Subject to Physical Damage: ERMC, IMC, PVC-80.
4. Concealed Aboveground: EMT.
5. Direct Buried: PVC-80, PVC-40.
6. Concrete Encased Not in Trench: PVC-80, PVC-40.
7. Concrete Encased in Trench: PVC-80, PVC-40.
8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC .

C. Indoors:

1. Hazardous Classified Locations: ERMC.
2. Exposed and Subject to Severe Physical Damage: ERMC. Locations include the following:

    a. Mechanical rooms.

3. Exposed and Subject to Physical Damage: EMT. Locations include the following:

    a. Locations less than 2.5 m (8 ft) above finished floor.
    b. Stub-ups to above suspended ceilings.

4. Exposed and Not Subject to Physical Damage: EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
6. Damp or Wet Locations: ERMC IMC.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC, FMC.

D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERMC and IMC: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
2. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
3. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
4. Type FMT: Article 360 of NFPA 70 and NECA NEIS 101.
5. Type IMC: Article 342 of NFPA 70 and NECA NEIS 101.
6. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
7. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
8. Expansion Fittings: NEMA FB 2.40.
9. Consult Contracting Officer for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

    a. Complete duct raceway installation before starting conductor installation.
    b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft (0.6 m) above finished floor.

c. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
d. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
e. Support conduit within 12 inch (300 mm) of enclosures to which attached.
f. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:

    1) Where an underground service duct raceway enters a building or structure.
    2) Conduit extending from interior to exterior of building.

g. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
h. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.
i. Keep duct raceways at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
j. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
k. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inch (300 mm) of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
l. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.

    1) Termination fittings with shoulders do not require two locknuts.

m. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

2. Types EMT-A, ERMC-A, and FMC-A: Do not install aluminum duct raceways or fittings in contact with concrete or earth.
3. Types ERMC and IMC:

a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.

4. Types FMC, LFMC, and LFNC:

   a. Provide a maximum of 36 inch (915 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

5. Types PVC:

   a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F (50 deg C). Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
   b. Comply with manufacturer's published instructions for solvent welding and fittings.

6. Stub-ups to Above Recessed Ceilings:

   a. Provide EMT, IMC, or ERMC for duct raceways.
   b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

7. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:

   a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.

8. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

   a. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
   b. EMT: Provide setscrew, steel fittings. Comply with NEMA FB 2.10.
   c. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

9. Expansion-Joint Fittings:

a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F (17 deg C) and that have straight-run length that exceeds 25 ft (7.6 m). Install in runs of aboveground ERMC and EMT conduit that are located where environmental temperature change may exceed 100 deg F (55 deg C) and that have straight-run length that exceeds 100 ft (30 m).
b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:

1) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
2) Attics: 135 deg F (75 deg C) temperature change.

c. 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.
d. Install expansion fittings at locations where conduits cross building or structure expansion joints.
e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

10. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.
11. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.

a. Provide warning signs.

D. Interfaces with Other Work:

1. Coordinate installation of firestopping at penetrations of fire-rated floor and wall assemblies.
2. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and 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

SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
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. ABB, Electrification Business.
    b. Arlington Industries, Inc.
    c. Crouse-Hinds; brand of Eaton, Electrical Sector.
    d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    h. MonoSystems, Inc.
    i. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    j. Pass & Seymour; Legrand North America, LLC.
    k. Patriot Aluminum Products, LLC.
    l. Plasti-Bond; Robroy Industries.
    m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    n. Spring City Electrical Manufacturing Company.
    o. Topaz Lighting & Electric.
    p. Wiremold; Legrand North America, LLC.

3. Options:

    a. Material: Sheet steel.
    b. Sheet Metal Depth: Minimum 1.5 inch (38 mm), 2 inch (50 mm), 2.5 inch (65 mm).
    c. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb (23 kg) more than 50 lb (23 kg) and marked with maximum allowable weight.

D. UL QCIT - Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
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. ABB, Electrification Business.
    b. Crouse-Hinds; brand of Eaton, Electrical Sector.
    c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    f. Pass & Seymour; Legrand North America, LLC.
    g. Patriot Aluminum Products, LLC.
    h. Plasti-Bond; Robroy Industries.
    i. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    j. Topaz Lighting & Electric.

E. UL QCIT - Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
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. ABB, Electrification Business.
    b. Arlington Industries, Inc.
    c. Crouse-Hinds; brand of Eaton, Electrical Sector.
    d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    i. Patriot Aluminum Products, LLC.
    j. Plasti-Bond; Robroy Industries.
    k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    l. Topaz Lighting & Electric.

3. Options:

    a. Material: Sheet steel.
    b. Sheet Metal Depth: minimum 1.5 inch (38 mm), 2 inch (50 mm), 2.5 inch (65 mm).

F. UL QCIT - Metallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
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. ABB, Electrification Business.
    b. Cooper B-line; brand of Eaton, Electrical Sector.
    c. Crouse-Hinds; brand of Eaton, Electrical Sector.
    d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    g. Pass & Seymour; Legrand North America, LLC.
    h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    i. Topaz Lighting & Electric.

G. UL QCIT - Metallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
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. ABB, Electrification Business.
    b. AFC Cable Systems; Atkore International.
    c. Arlington Industries, Inc.
    d. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
    e. FSR Inc.
    f. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    h. Leviton Manufacturing Co., Inc.
    i. Pass & Seymour; Legrand North America, LLC.
    j. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    k. Wiremold; Legrand North America, LLC.

H. UL QCIT - Metallic Concrete Boxes and Covers:

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. ABB, Electrification Business.
b. Crouse-Hinds; brand of Eaton, Electrical Sector.
c. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
d. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
e. Topaz Lighting & Electric.
f. Wiremold; Legrand North America, LLC.

2.2 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCMZ; including UL 514C.

B. UL QCMZ - Nonmetallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.
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. ABB, Electrification Business.
b. Allied Tube & Conduit; Atkore International.
c. Arlington Industries, Inc.
d. Cantex Inc.
e. JM Eagle; J-M Manufacturing Co., Inc.
f. Pass & Seymour; Legrand North America, LLC.
g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
h. Wiremold; Legrand North America, LLC.

2.3 JUNCTION BOXES AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
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. Adalet.
    b. Cooper B-line; brand of Eaton, Electrical Sector.
    c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    d. FSR Inc.
    e. Hoffman; brand of nVent Electrical plc.
    f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    h. Milbank Manufacturing Co.
    i. N J Sullivan Company.
    j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    l. Spring City Electrical Manufacturing Company.
    m. Square D; Schneider Electric USA.

3. Options:

    a. Degree of Protection: Type 1.

D. UL BGUZ - Indoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
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. Adalet.
    b. Crouse-Hinds; brand of Eaton, Electrical Sector.
    c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.

3. Options:

    a. Degree of Protection: Type 1.

E. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
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. Adalet.
    b. Cooper B-line; brand of Eaton, Electrical Sector.
    c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    d. FSR Inc.
    e. Hoffman; brand of nVent Electrical plc.
    f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    h. Milbank Manufacturing Co.
    i. N J Sullivan Company.
    j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
    k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    l. Spring City Electrical Manufacturing Company.
    m. Square D; Schneider Electric USA.

3. Options:

    a. Degree of Protection: Type 3R.

F. UL BGUZ - Outdoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
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. Adalet.
    b. Crouse-Hinds; brand of Eaton, Electrical Sector.
    c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.

3. Options:

    a. Degree of Protection: Type 3R.

G. UL BGUZ - Outdoor Polymeric Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
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. ABB, Electrification Business.
    b. Allied Tube & Conduit; Atkore International.
    c. Cantex Inc.
    d. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    e. JM Eagle; J-M Manufacturing Co., Inc.
    f. Robroy Enclosures; Robroy Industries.
    g. Topaz Lighting & Electric.

3. Options:

    a. Degree of Protection: Type 3R.

2.4 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

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. ABB, Electrification Business.
    b. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
    c. Crouse-Hinds; brand of Eaton, Electrical Sector.
    d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
g. Intermatic, Inc.
h. Leviton Manufacturing Co., Inc.
i. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
j. Panduit Corp.
k. Pass & Seymour; Legrand North America, LLC.
l. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
m. Topaz Lighting & Electric.
n. Wiremold; Legrand North America, LLC.

2. Options:

a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
b. Wallplate Material: 0.032 inch (0.8 mm) thick, Type 302/304 non-magnetic stainless steel with brushed finish Galvanized steel.

D. UL QCIT or QCMZ - Nonmetallic Cover Plates for Device Boxes:

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. ABB, Electrification Business.
b. Arlington Industries, Inc.
c. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
d. Crouse-Hinds; brand of Eaton, Electrical Sector.
e. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
f. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
h. Intermatic, Inc.
i. Leviton Manufacturing Co., Inc.
j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
k. Panduit Corp.
l. Pass & Seymour; Legrand North America, LLC.
m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
n. Topaz Lighting & Electric.
o. Wiremold; Legrand North America, LLC.

2. Options:

a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.

b. Wallplate Material: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
c. Color: White.

2.5 HOODS FOR OUTLET BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria:

   a. UL CCN QCIT or UL CCN QCMZ; including UL 514D.
   b. Receptacle, Hood, Cover Plate, Gaskets, and Seals: UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.

3. Mounts to box using fasteners different from wiring device.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT or QCMZ - Extra-Duty, While-in-Use Hoods for Outlet Boxes:

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. ABB, Electrification Business.
   b. Allied Tube & Conduit; Atkore International.
   c. Arlington Industries, Inc.
   d. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   e. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Intermatic, Inc.
   g. Leviton Manufacturing Co., Inc.
   h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2. Additional Characteristics: Marked "Extra-Duty" in accordance with UL 514D.
3. Options:

   a. Provides gray, weatherproof, "while-in-use" cover.
   b. Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Contracting Officer for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:

a. Type 3R unless otherwise indicated.

2. Indoors:

a. Type 1 unless otherwise indicated.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:

1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
2. Consult Contracting Officer for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. 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.
3. 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, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.

9. Set metal floor boxes level and flush with finished floor surface.
10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

    a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    b. Provide gaskets for wallplates and covers.

14. Identification: Provide labels for boxes and associated electrical equipment.

    a. Identify field-installed conductors, interconnecting wiring, and components.
    b. Provide warning signs.
    c. Label each box with engraved metal or laminated-plastic nameplate.

D. Interfaces with Other Work:

1. Coordinate with Section 260573.13 "Short-Circuit Studies" for determining available fault current on input feeder.
2. Coordinate with Section 260573.19 "Arc-Flash Hazard Analysis" for determining arc-flash hazard on input feeder.

3.3 CLEANING

A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.4 PROTECTION

A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Government.

END OF SECTION

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Tapes and stencils.
3. Signs.
4. Cable ties.
5. Miscellaneous identification products.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Labels.
2. Tapes and stencils.
3. Signs.
4. Cable ties.
5. Miscellaneous identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

C. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
2. Colors for 208Y/120 V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Color for Neutral: White.
4. Color for Equipment Grounds: Green.

B. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

C. Equipment Identification Labels:

1. Black letters on white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

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. Brady Corporation.
b. Champion America.

c. Grafoplast Wire Markers.
d. HellermannTyton.
e. LEM Products Inc.
f. Marking Services Inc.
g. Panduit Corp.
h. Seton Identification Products; a Brady Corporation company.
i. emedco.

B. Self-Adhesive Wraparound Labels: Preprinted, 3 mil (0.08 mm) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

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. A'n D Cable Products.
b. Brady Corporation.
c. Brother International Corporation.
d. Grafoplast Wire Markers.
e. Ideal Industries, Inc.
f. LEM Products Inc.
g. Marking Services Inc.
h. Panduit Corp.
i. Seton Identification Products; a Brady Corporation company.
j. emedco.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
3. Marker for Labels:

a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

C. Self-Adhesive Labels: Vinyl, 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. 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. A'n D Cable Products.
b. Brady Corporation.
c. Brother International Corporation.
d. Grafoplast Wire Markers.
e. HellermannTyton.
f. Ideal Industries, Inc.
g. LEM Products Inc.
h. Marking Services Inc.

i. Panduit Corp.
j. Seton Identification Products; a Brady Corporation company.
k. emedco.

2. Minimum Nominal Size:

a. 1-1/2 by 6 inch (37 by 150 mm) for raceway and conductors.
b. 3-1/2 by 5 inch (76 by 127 mm) for equipment.

2.4 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.

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. Carlton Industries, LP.
b. Champion America.
c. HellermannTyton.
d. Ideal Industries, Inc.
e. Marking Services Inc.
f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil (0.08 mm) thick by 1 to 2 inch (25 to 50 mm) wide; compounded for outdoor use.

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. Brady Corporation.
b. Carlton Industries, LP.
c. Marking Services Inc.
d. emedco.

C. Underground-Line Warning Tape:

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

a. Brady Corporation.
b. Ideal Industries, Inc.
c. LEM Products Inc.
d. Marking Services Inc.
e. Pipemarker.com; Brimar Industries, Inc.

f. Reef Industries, Inc.
g. Seton Identification Products; a Brady Corporation company.

2. Tape:

a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape must be permanent and may not be damaged by burial operations.
c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".

2.5 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:

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. Brady Corporation.
b. Carlton Industries, LP.
c. Marking Services Inc.
d. Seton Identification Products; a Brady Corporation company.
e. emedco.

2. Engraved legend.
3. Thickness:

a. For signs up to 20 sq. inch (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
b. For signs larger than 20 sq. inch (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, Self-adhesive.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 CABLE TIES

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. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services Inc.
4. Panduit Corp.

B. 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) in accordance with ASTM D638: 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.

C. 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) in accordance with ASTM D638: 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.

2.7 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 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 1000 V: Identification must 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 1000 V: Identification must 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. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.

K. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

L. Self-Adhesive Labels:

1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

2. Unless otherwise indicated, provide 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 inch (50 mm) high.

M. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

N. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

O. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in common trench exceeds 16 inch (400 mm) overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

P. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide 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 inch (50 mm) high.

Q. 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. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

B. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

C. Arc Flash Warning Labeling: Self-adhesive labels.

D. Equipment Identification Labels:

1. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
b. Switchboards.
c. Power-transfer equipment.

END OF SECTION

SECTION 260800 – ELECTRICAL COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

A. The purpose of this section is to specify the Division 26 responsibilities and participation in the commissioning process. See Division 1, Section 019100, "General Commissioning Requirements," for Contractor-related commissioning requirements.

B. Organization of the commissioning program is primarily the responsibility of the Commissioning Authority. Execution of the program is primarily the responsibility of the Contractor with support from the Division 26 Sub-contractor.

C. Division 26 Contractor shall cooperate with the Commissioning Authority in the following manner:

1. Allow sufficient time before final completion dates so that installation verification, start-up, test, adjust and balance, controls point-to-point checkout, system check-out and functional testing can be accomplished for all needed equipment. Tasks need to be shown on project schedule.
2. Complete startup of the electrical equipment and systems. Provide copies of completed manufactures startup forms or Commissioning Authority provided system check-out forms
3. Complete and endorse all system readiness forms provided by the Commissioning Authority to assure that Division 26 equipment and systems are fully operational and ready for functional testing.
4. Assemble a copy of all records of Code Authority inspections and approvals to be submitted to the Commissioning Authority.
5. Providing qualified personnel to operate equipment and systems as required to assist the Commissioning Authority with functional testing to verify performance of equipment/system.
6. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements. Deficiencies need to be corrected without undue delay.
7. Put all electrical systems and equipment into full operation and continue the operation of the same during each working day of commissioning.
8. Provide operation and maintenance information and as-built drawings so that they can be used during functional testing and training.
9. Providing training for the systems specified in Division 26 with coordination of Government by the Contractor.

1.2 SCOPE OF COMMISSIONING

A. The following are to be commissioned:

1. Automatic Lighting Controls.
    a. Lighting Levels.
    b. Occupancy sensing.
    c. Daylight Harvesting.
    d. Verification of system integration.
    e. Overall functionality.
    f. Performance submittals.
    g. Lighting system operation checklists.

B. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.3 RELATED REQUIREMENTS

A. Drawings and general provisions of contract documents.

B. Division 1 specification sections applicable to related scope of work outlined above.

C. Division 26 specification sections identify the requirements for electrical systems relating to the installation of electrical equipment and systems, particularly with respect to equipment and system testing, start-up and performance demonstration/observation.

1.4 TERMS

A. Acceptable Performance: A component or system being able to meet specified design parameters under actual load, including satisfactory documented completion of all functional performance tests, control system trending, and resolution of outstanding issues.

B. Commissioning Authority: An independent and knowledgeable third party hired to verify that the systems achieve acceptable performance. Independent third party means that the Commissioning Authority cannot be financially associated with any of the Project's Contractors or Vendors to avoid potential conflicts of interest. The person performing the testing of the system. This person is knowledgeable in the systems being tested.

C. Commissioning Team: The term used to define the overall group associated with performing commissioning work, including designated representatives of the Government, Facilities Staff, Design Professionals, Construction Team, and the Commissioning Authority.

D. Construction Team: The term used to define the overall group responsible for performing the work required to comply with the Contract Documents, including the Construction Manager, Contractor, the Mechanical Contractor and associated subcontractors, the Electrical Contractor and associates subcontractors.

E. Design Intent: The ideas and documentation behind design decisions that were made to meet the Government's project requirements. The design intent describes the systems, components, conditions and methods to provide a fully functioning building.

F. Functional Performance Testing: Full range of checks, tests and demonstrations carried out to determine that all components, sub-systems, systems, and interfaces between the systems function

in accordance with the Contract Documents. In this context, function includes all modes and sequences of control and operation, all interlocks and conditional control responses, and all specified responses to abnormal emergency conditions.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The Contractor will provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Government.

B. Calibration Tolerances: The Contractor will provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:

1. Watthour, Voltage, Amperage: 1% of design.
2. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.

C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Government; such equipment, tools, and instruments are to become the property of Government.

D. Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment that is required for Functional Tests will be provided by the Contractor or Commissioning Authority and will not become the property of the Government.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor and Contractors shall be responsible for performing all procedures presented in the specification and contract drawings, unless otherwise specified. The Commissioning Agent will witness system start up and functional performance for all systems listed in this division.

3.2 WORK PRIOR TO FUNCTIONAL TESTING

A. A commissioning plan will be developed by the Commissioning Authority and approved by the Government's Representative.

1. Division 26 is obligated to assist the Commissioning Authority in preparing the commissioning plan by providing all necessary information pertaining to the actual equipment and installation.

2. If system modifications/clarifications are called for in the contractual requirements of this and related sections of work, they will be made at no additional cost to the Government.
3. If Contractor-initiated system changes have been made that alter the commissioning process, the Contractor will notify the Government's Representative for approval.

B. Specific responsibilities of Division 26 are as follows:

1. Participate in any efforts to finalize sequences of operations with Government, Designers, and Commissioning Authority. The schedule should allow sufficient time before final completion dates so that installation verification, start-up, controls point-to-point checkout, system check-out and functional testing can be accomplished for all needed equipment. Tasks need to be shown on project schedule
2. Normal start-up services required to bring each system and sub-system into a fully operational state per the contract documents and related directives, clarifications, change orders, etc. This includes phase rotation check, cleaning, grounding, control sequences of operation, continuity testing, full-load and part-load performance, etc.
3. Collect and provide to the Commissioning Authority specification required documentation as requested and outlined in the Commissioning Field Notebook.
4. Review the Commissioning Field Notebook, Commissioning Plan, Project Communication Reports, and Issues Resolution Log and submit comments to the Commissioning Authority as needed.
5. Provide equipment submittals for systems to be commissioned to the Commissioning Authority.
6. Provide Commissioning Authority with controls system wiring diagrams and narrative sequences of operation in time for use in preparing the functional test procedures.
7. Participate in commissioning meetings with the Commissioning Authority.
8. Complete and endorse all system readiness forms provided by the Commissioning Authority to assure that Division 26 equipment and systems are fully operational and ready for functional testing.
9. Provide schedule of activities, forms, and other documentation to the Commissioning Authority and Government's Representative at least two (2) weeks minimum prior to any startup or testing required by the Contract Documents.
10. Assemble a copy of all records of Code Authority inspections and approvals to be submitted to the Commissioning Authority. Place documentation in Commissioning Field Notebook.
11. Issue System Readiness form for each set of equipment to the Commissioning Authority upon completion of all component installation, start-up documentation, system work and testing requirements per specification for all Contractors.
12. Provide qualified personnel for participation in site inspections, commissioning tests, including seasonal testing required and warranty end testing required after the initial commissioning.
13. Provide engineering and technical expertise to oversee and direct the correction of deficiencies found during the commissioning process. This includes providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements. Deficiencies need to be corrected without undue delay.
14. Put all electrical systems and equipment into full operation, and continue the operation of the same during each working day of commissioning.

15. Note any inconsistencies or deficiencies in system operations and enforce system compliance or recommend to the Commissioning Authority, Government's Representative and A/E modifications to system design, which will enhance system performance.
16. In the event that a functional test fails, the cause of failure shall be determined and rectified as soon as possible, and then retested. If more than two functional tests of the same system(s) are required, all costs for additional testing may be borne by the Contractor, at the Government's discretion.
17. Operate equipment and systems, as required, for functional performance testing. This includes, but is not limited to; manipulating the appropriate controls systems to achieve the expected response for the functional test procedure.
18. Participate in the fine-tuning or troubleshooting of system performance if either of these measures becomes necessary.
19. Review operation and maintenance information and as-build drawings provided by the various subcontractors and vendors for verification, organization, and distribution. Report any discrepancies to Commissioning Authority and the Government's Representative.
20. Submit complete operation and maintenance information, and as-built drawings in electronic form to the Commissioning Authority for review. (Adobe PDF preferred)
21. Obtain all documentation from completed installation audit forms, startup forms, and functional performance tests and assemble the components in the Commissioning Field Notebook and submit the completed notebook to the Commissioning Authority for review and approval.
22. Oversee and provide training for the systems specified in all specification Divisions with coordination by the Mechanical and Electrical Subcontractors.
23. Provide documentation of training for the systems specified.

C. Factory start-up services for key equipment and systems specified in Division 26. The Division 26 Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.

D. The Contractor will not begin the functional testing until each system is completely installed and system readiness form has been approved by the Commissioning Authority.

1. Functional testing is intended to begin upon completion of a system. The Commissioning Authority will not begin the functional testing process until each system is complete and documented. If possible, testing may proceed prior to the completion of systems and/or sub-systems if expediting this work is in the best interests of the Government. Testing prior to system completion will have a cost impact. Start of functional testing before system completion will not relieve Division 26 from completing those systems as per the schedule.
2. Red-lined as-built drawings shall be available during commissioning.

3.3 PARTICIPATION IN FUNCTIONAL TESTING

A. Provide skilled technicians to start-up and debug all systems within the Division 26 work (particularly with controls equipment). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed upon schedules, and of sufficient duration to complete the necessary tests, adjustments and/or problem resolutions.

1. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority with a qualified factory representative does not constitute the availability of a qualified technician for purposes of this work.

B. System problems and discrepancies may require additional technician time which shall be made available for the subsequent commissioning periods until required system performance is obtained.

C. The objective of functional performance testing is to advance the building systems from a state of substantial completion to full dynamic operation in accordance with the specified design requirements and design intent.

D. The Commissioning Authority shall direct system-testing protocols which, when implemented by the Contractor, will allow the Commissioning Authority to observe, evaluate, identify deficiencies, recommend modifications, tune, and document the systems and systems' equipment performance over a range control modes of operation.

3.4 WORK TO RESOLVE DEFICIENCIES

A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet Acceptable Performance. Correction of work will be completed under the direction of the Government's Representative and Contracting Officer, with input from the Contractor, Equipment Supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Contracting Officer will have final jurisdiction on the necessary work to be done to achieve performance and/or design intent.

B. Corrective work shall be completed in a timely fashion to permit timely completion of the commissioning process.

1. Experimentation to render system performance will be permitted.

a. If the Contracting Officer deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Contracting Officer will notify the Government indicating the nature of the problem, expected steps to be taken, and the deadline for completion of activities.
b. If deadlines pass without resolution of the problem, the Government reserves the right to obtain supplementary services and/or equipment to resolve the problem.
c. Costs incurred to solve the problem in an expeditious manner will be the Contractor's responsibility.

3.5 PERFORMANCE PERIOD

A. Upon successful completion of functional test procedures, a performance period of 15 consecutive calendar days shall commence on first day following the last performance test. This period shall be completed prior to final acceptance of the project. In event of failure to meet standard of performance during any initiated performance period, it is not required that one 15-calendar day period expire in order for another performance period to begin.

B. If equipment or system operation demonstrates continuing compliance with specified requirements for a period of 15 consecutive calendar days from commencement date of performance period, it shall be deemed to have met the standard of performance.

C. Equipment will not be accepted by the Government and final payment will not be made by the Government until acceptable performance is met.

3.6 RETESTING AND RECOMMISSIONING

A. Contractor is responsible for correction of deficiencies and retesting at no extra cost to Government; if a deficiency is not corrected and retested immediately, the Commissioning Authority will document the deficiency.

1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
2. When the deficiency has been corrected, the Contractor needs to notify the Commissioning Authority that the item is ready to be retested; the Commissioning Authority will reschedule the test and the Contractor shall retest.
3. Identical or Near-Identical Items: If ten percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
4. The Contractor will be allowed one retest by the Commissioning Authority after initial testing of the equipment. If equipment fails testing a second time the Contractor shall bear the cost of Government and Commissioning Authority's time for any additional retesting.
5. Contractor shall bear the cost of Government and Commissioning Authority's time for any retesting if the test failed due to failure to execute the relevant system readiness forms and/or system check-out forms correctly and any subsequent retests.

3.7 TRAINING

A. The Division 26 Contractor will be required to participate in the training of the Government's engineering and maintenance staff for each mechanical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Government's option.

B. A training plan will be developed by the Contractor outlining equipment that requires training. The plan shall include who will perform the training, when the training will occur, and the required duration of the training. Once the training plan is developed the Government will provide a list of the appropriate personnel attending the training.

C. Training sessions should cover using the Operations & Maintenance Manuals and as-built drawings assembled by the Contractor as tools for understanding and troubleshooting components, equipment and systems. This material needs to be supplied to the Government a minimum of two weeks prior to training taking place to allow participants time to review the material. This helps focus training needs of the O & M staff.

D. Detailed requirements for training and instruction are contained in other sections of these Contract Documents. The Contractor needs to document what training has taken place and those that have attended training.

3.8 MISCELLANEOUS SUPPORT

A. Division 26 shall remove and replace covers of electrical equipment, open access panels, etc., to permit Contractor, Government's Representative and Commissioning Authority to observe equipment and controllers provided. Furnish ladders and flashlights as necessary.

END OF SECTION 260800

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electronic dial-time switches.
2. Daylight-harvesting switching controls.
3. Daylight-harvesting dimming controls, digital.
4. Indoor occupancy and vacancy sensors.
5. Switchbox-mounted occupancy sensors.
6. Conductors and cables.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Electronic dial-time switches.
2. Daylight-harvesting switching controls.
3. Daylight-harvesting dimming controls, digital.
4. Indoor occupancy and vacancy sensors.
5. Switchbox-mounted occupancy sensors.
6. Room controllers.
7. Plug load controllers.
8. Emergency shunt relay.
9. Conductors and cables.

B. Shop Drawings:

1. Show installation details for the following:

   a. Occupancy sensors.
   b. Switches.
   c. Daylight sensors.
   d. Room controllers.
   e. Plug load controllers.

2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.3 WARRANTY

A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.

1. Failures include, but are not limited to, the following:

   a. Faulty operation of lighting control software.
   b. Faulty operation of lighting control devices.

2. Extended Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

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. Eaton.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. Schneider Electric USA, Inc.
6. TE Connectivity Ltd.
7. Touché Lighting Control.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 20 A ballast load, 120/240 V(ac).
4. Programs:

   a. Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.

5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
6. Astronomic Time: All channels.
7. Automatic daylight savings time changeover.
8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 DAYLIGHT-HARVESTING SWITCHING CONTROLS

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. Eaton.
2. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
3. Leviton Manufacturing Co., Inc.
4. Lithonia Lighting; Acuity Brands Lighting, Inc.
5. NSi Industries LLC.
6. Sensor Switch, Inc.
7. TE Connectivity Ltd.
8. WattStopper; Legrand North America, LLC.

B. Description: System operates indoor lighting.

C. Sequence of Operation: As daylight increases, the lights are turned off at a predetermined level. As daylight decreases, the lights are turned on at a predetermined level.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present.
b. When significant daylight is present (target level).
c. System programming is done with two hand-held, remote-control tools.

D. Ceiling-Mounted Switching Controls:

1. Solid-state, light-level sensor unit, with separate power pack, that detects changes in indoor lighting levels that are perceived by the eye.

E. Electrical Components, Devices, and Accessories:

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
3. Sensor Output:

a. Contacts rated to operate the associated power pack, complying with UL 773A. Sensor must be powered by the power pack.

4. Sensor type: Open loop, Closed loop.
5. Zone: Single.
6. Power Pack:

a. Dry contacts rated for 20 A LED load at 120- and 277 V(ac), for tungsten at 120 V(ac), and for at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.

1) LED status lights to indicate load status.
2) Plenum rated.

7. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lx), with an adjustment for turn-on and turn-off levels within that range.
8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
11. Control Load Status: User selectable to confirm that load wiring is correct.
12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.3 DAYLIGHT-HARVESTING DIMMING CONTROLS, DIGITAL

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. Deep Roof Lighting.
2. Eaton.
3. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
4. Leviton Manufacturing Co., Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.
6. WattStopper; Legrand North America, LLC.

B. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, lights are dimmed.

1. Lighting control set point is based on the following two lighting conditions:

a. When no daylight is present (target level).
b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.
b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.

D. Electrical Components, Devices, and Accessories:

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Sensor Output: zero to 10 V(dc) to operate luminaires. Sensor is powered by controller unit.
3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lx).

E. Power Pack: Digital controller capable of accepting 2 8PSJ inputs with two output(s) rated for 20 A LED load at 120 and 277 V(ac), for at 120 and 277 V(ac), and for at 120 V(ac). Sensor has 24 V(dc) Class 2 power source.

1. With integral current monitoring.
2. Compatible with digital addressable lighting interface.
3. Plenum rated.

2.4 INDOOR OCCUPANCY AND VACANCY SENSORS

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. Bryant; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Douglas Lighting Controls.
3. Eaton.
4. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
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. Philips; Signify North America; Signify Holding.
11. RAB Lighting.
12. Sensor Switch, Inc.
13. Square D; Schneider Electric USA.
14. WattStopper; Legrand North America, LLC.

B. General Requirements for Sensors:

1. Wall, Ceiling-mounted, solid-state indoor occupancy sensors.

2. Dual technology.
3. Separate power pack.
4. Hardwired connection to switch.
5. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, 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.

7. Sensor Output: Sensor is powered from the power pack.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20 A LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
10. Mounting:

    a. Sensor: Suitable for mounting in any position in 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 lx); turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling 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. inch (23 200 sq. mm), and detect a person of average size and weight moving not less than 12 inch (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inch/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 2000 sq. ft. (220 sq. m) when mounted 48 inch (1200 mm) above finished floor.

2.5 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

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. Bryant; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Douglas Lighting Controls.
3. Eaton.
4. Hubbell Control Solutions; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
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. Philips; Signify North America; Signify Holding.
11. RAB Lighting.
12. Sensor Switch, Inc.
13. Square D; Schneider Electric USA.
14. WattStopper; Legrand North America, LLC.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchboxusing hardwired connection.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
4. Switch Rating: Not less than 800 VA LED load at 120 V.

2.6 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 instructions.

3.3 INSTALLATION OF WIRING

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.

C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 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.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Nonconforming Work:

1. Lighting control devices will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Prepare test and inspection reports.

3.6 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 Government's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Government's operations.

3.7 MAINTENANCE

A. Software and Firmware Service Agreement:

1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for two years.
2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.

   a. Upgrade Notice: No fewer than 30 days to allow Government to schedule and access the system and to upgrade computer equipment if necessary.

3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade duplex straight-blade receptacles.
3. Receptacles with arc-fault and ground-fault protective devices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.2 DEFINITIONS

A. Commercial/Industrial-Use Cord Reel: A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service-type cord.

B. UL 1472 Type I Dimmer: Dimmer in which air-gap switch is used to energize preset lighting levels.

1.3 ACTION SUBMITTALS

A. Product Data:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade duplex straight-blade receptacles.
3. Receptacles with arc-fault and ground-fault protective devices.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

A. Toggle Switch :

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. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
    b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour; Legrand North America, LLC.

2. Regulatory Requirements:

    a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

    a. Reference Standards: UL CCN WMUZ and UL 20.

4. Options:

    a. Device Color: White.
    b. Configuration:

        1) General-duty, 120-277 V, 20 A, single pole, three way, four way.

5. Accessories:

    a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
    b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle :

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. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
    b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour; Legrand North America, LLC.

2. Regulatory Requirements:

    a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

    a. Reference Standards: UL CCN RTRT and UL 498.

4. Options:

    a. Device Color: White.
    b. Configuration:

        1) Heavy-duty, NEMA 5-20R.

5. Accessories:

    a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
    b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

B. Wired Half-Controlled Duplex Straight-Blade Receptacle :

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. Hubbell Lighting; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    c. Pass & Seymour; Legrand North America, LLC.

2. Regulatory Requirements:

    a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

    a. Reference Standards: UL CCN RTXI and UL Subject 498B.

4. Options:

    a. Device Color: White .

b. Configuration: NEMA 5-20R.

5. Accessories:

a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 RECEPTACLES WITH ARC-FAULT AND GROUND-FAULT PROTECTIVE DEVICES

A. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device :

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. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour; Legrand North America, LLC.

2. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

3. General Characteristics:

a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.

4. Options:

a. Device Color: White.
b. Configuration: Heavy-duty, NEMA 5-20R.

5. Accessories:

a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Government-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 SELECTION OF GFCI RECEPTACLES

A. Unless protection of downstream branch-circuit wiring, cord sets, and power-supply cords is required by NFPA 70 or NFPA 99, provide non-feed-through GFCI receptacles.

3.3 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Contracting Officer for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

   a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black -filled lettering, and provide durable wire markers or tags inside device box or outlet box.

3.4 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.

2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Contracting Officer for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black -filled lettering, and provide durable wire markers or tags inside device box or outlet box.

3.5 FIELD QUALITY CONTROL OF SWITCHES

A. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.

B. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

D. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.6 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

B. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

D. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.7 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Government.

END OF SECTION

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. Control circuits.
b. 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. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Coordination charts and tables and related data.
4. Fuse sizes 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 017823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.

2. 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Littelfuse, Inc.
4. Mersen USA.

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: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type RK-5: 250-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.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

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. Motor Branch Circuits: Class RK5, time delay.
2. 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.

END OF SECTION

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonfusible switches.
2. Molded-case circuit breakers (MCCBs).
3. Enclosures.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. GFEP: Ground-fault circuit-interrupter for equipment protection.

B. GFLS: Ground-fault circuit-interrupter for life safety.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data:

1. 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.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

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.

1.4 CLOSEOUT SUBMITTALS

A. Warranty documentation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain products from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 NONFUSIBLE SWITCHES

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. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, 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. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

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. ABB, Electrification Business.
2. Eaton.
3. NOARK Electric North America.
4. Siemens Industry, Inc., Energy Management Division.
5. Square D; Schneider Electric USA.

B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.

C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

D. MCCBs must be equipped with device for locking in isolated position.

E. Lugs must be suitable for 75 deg C rated wire.

F. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.

G. 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.

H. 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.

2.4 ENCLOSURES

A. Enclosure Finish: Enclosure must be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1) gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (UL 50E Types 3R, 12).

B. Operating Mechanism: Circuit-breaker operating handle must be directly operable through front cover of enclosure (UL 50E Type 1) directly operable through dead front trim of enclosure (UL 50E Type 3R). Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.

C. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.

D. UL 50E Type 7/9 enclosures must be furnished with breather and drain kit to allow their use in outdoor and wet location applications.

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 will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

A. Indoor, Dry and Clean Locations: UL 50E, Type 1.

B. Outdoor Locations: UL 50E, Type 3R.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. 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.
2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
4. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 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.

3.5 FIELD QUALITY CONTROL

A. 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 unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use 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 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 must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.

f. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
g. Verify correct phase barrier installation.
h. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

B. 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 Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that unit is clean.
e. Operate circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use 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 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 must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

2. Test and adjust controls, remote monitoring, and safeties.

C. Nonconforming Work:

1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit 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.

E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.7 PROTECTION

A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Government.

END OF SECTION

SECTION 262913.03 - MANUAL AND MAGNETIC 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:

1. Manual motor controllers.
2. Combination full-voltage magnetic motor controllers.
3. Enclosures.
4. Accessories.
5. Identification.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. NC: Normally closed.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SCPD: Short-circuit protective device.

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.

B. Shop Drawings: For each type of magnetic controller.

1. Include plans, elevations, sections, and mounting details.

2. Indicate dimensions, weights, required clearances, and location and size of each field connection.
3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Routine maintenance requirements for magnetic controllers and installed components.
b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
c. Manufacturer's written instructions for setting field-adjustable overload relays.
d. 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.
e. 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.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 FIELD CONDITIONS

A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 23 deg F (minus 5 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m) for electromagnetic and manual devices.
3. The effect of solar radiation is not significant.

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 use.

B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.

C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.

D. Seismic Performance: Magnetic controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the controller 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."
2. Component Importance Factor: 1.0.

2.2 MANUAL MOTOR CONTROLLERS

A. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

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. Eaton.
b. General Electric Company.
c. Rockwell Automation, Inc.
d. Siemens Industry, Inc., Energy Management Division.
e. Square D; by Schneider Electric.

2. Standard: Comply with NEMA ICS 2, general purpose, Class A.

3. Configuration: Nonreversing.
4. Surface mounting.

B. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

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. Eaton.
b. General Electric Company.
c. Rockwell Automation, Inc.
d. Siemens Industry, Inc., Energy Management Division.
e. Square D; by Schneider Electric.

2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.

C. Integral Horsepower Manual Controllers (IHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

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. Eaton.
b. General Electric Company.
c. Rockwell Automation, Inc.
d. Siemens Industry, Inc., Energy Management Division.
e. Square D; by Schneider Electric.

2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
4. Overload Relays: NEMA ICS 2, bimetallic class as scheduled on Drawings.

2.3 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.

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. Eaton.
2. General Electric Company.
3. Rockwell Automation, Inc.
4. Siemens Industry, Inc., Energy Management Division.
5. Square D; by Schneider Electric.

C. Standard: Comply with NEMA ICS 2, general purpose, Class A.

D. Configuration: Nonreversing.

E. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.

1. Operating Voltage: Manufacturer's standard, unless indicated.

F. Overload Relays:

1. Thermal Overload Relays:

a. Inverse-time-current characteristic.
b. Class 10 tripping characteristic.
c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
d. Ambient compensated.
e. Automatic resetting.

G. Nonfusible Disconnecting Means:

1. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.4 ENCLOSURES

A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.

B. The construction of the enclosures shall comply with NEMA ICS 6.

C. Controllers in hazardous (classified) locations shall comply with UL 1203.

2.5 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.

B. Motor protection relays shall be with solid-state sensing circuit and isolated output contacts for hardwired connections.

1. Phase-failure.
2. Phase-reversal, with bicolor LED to indicate normal and fault conditions. Automatic reset when phase reversal is corrected.
3. Under/overvoltage, operate when the circuit voltage reaches a preset value, and drop out when the operating voltage drops to a level below the preset value. Include adjustable time-delay setting.

2.6 IDENTIFICATION

A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.

C. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

E. 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.

F. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

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 SYSTEM FUNCTION TESTS

A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.

1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
3. Verify the correct operation of sensing devices, alarms, and indicating devices.

B. Motor controller will be considered defective if it does not pass the system function tests and inspections.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Government's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION

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:

1. Materials.
2. 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.

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, IES LM-79 and IES LM-80.

    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.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:

1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance:

1. Luminaires shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
2. Luminaires and lamps shall be labeled vibration and shock resistant.
3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

B. Ambient Temperature: 5 to 104 deg F (Minus 15 to plus 40 deg C).

1. Relative Humidity: Zero to 95 percent.

2.2 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.

2.3 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 A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.
2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.4 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.

2.5 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 A641/A641M, 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 Contracting Officer, 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.

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. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

E. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaires:

1. Ceiling Mount:

a. Two 5/32-inch- (4-mm-) Insert value diameter aircraft cable supports adjustable to 10 feet (3 m) in length.

2. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
3. 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.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
5. 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 luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

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.

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 Contracting Officer.

END OF SECTION

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exit signs.
2. Materials.
3. Luminaire support components.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. Correlated Color Temperature (CCT): The absolute temperature, measured in kelvins, of a blackbody whose chromaticity most nearly resembles that of the light source.

B. Color Rendering Index (CRI): Measure of the degree of color shift that objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference source.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Lumen (lm): The SI derived unit of luminous flux equal to the luminous flux emitted within a unit solid angle by a unit point source (1 lm = 1 cd-sr).

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of exit sign and support.

a. Include data on features, accessories, and finishes.
b. Include physical description of unit and dimensions.
c. Battery and charger for light units.
d. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.

e. Include photometric data and adjustment factors based on laboratory tests by, or under supervision of, qualified luminaire photometric testing laboratory, for each luminaire type.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

PART 2 - PRODUCTS

2.1 EXIT SIGNS

A. General Characteristics: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Sign :

1. Options:

a. Operating at nominal voltage of 120 V(ac).
b. Lamps for AC Operation:

1) LEDs; 50,000 hours minimum rated lamp life.

2.2 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components must 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.

C. Housings:

1. Engineering-grade thermoplastic housing.
2. finish.

D. Conduit: EMT, FMC, minimum metric designator 21 (trade size 3/4).

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 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 A641/A641M, Class 3, soft temper, zinc-coated steel, 0.106 inch (2.69 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. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

B. Install lamps in each luminaire.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices must be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

D. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

E. Suspended Luminaire Support:

1. 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.
2. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Ceiling Grid Mounted Luminaires:

1. Secure to outlet box, if provided.
2. 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 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect luminaires. Replace lamps, exit signs, and luminaires that are defective.

a. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

3.5 PROTECTION

A. Remove and replace luminaires and exit signs that are damaged or caused to be unfit for use by construction activities.

END OF SECTION

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Category 6a twisted pair cable.
2. Twisted pair cable hardware.
3. Identification products.

1.2 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. FTP: Shielded twisted pair.

D. F/FTP: Overall foil screened cable with foil screened twisted pair.

E. F/UTP: Overall foil screened cable with unscreened twisted pair.

F. IDC: Insulation displacement connector.

G. Jack: Also commonly called an "outlet," it is the fixed, female connector.

H. LAN: Local area network.

I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

J. RCDD: Registered Communications Distribution Designer.

K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

M. S/FTP: Overall braid screened cable with foil screened twisted pair.

N. S/UTP: Overall braid screened cable with unscreened twisted pairs.

O. UTP: Unscreened (unshielded) twisted pair.

1.3 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable 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.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Category 6a twisted pair cable.
2. Twisted pair cable hardware.
3. Identification products.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Technician, 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.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.7 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.

1.8 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.

1.9 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Government's telecommunications and LAN equipment and service suppliers.

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:

a. Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. RoHS compliant.

2.3 CATEGORY 6a TWISTED PAIR CABLE

A. Category 6a Twisted Pair Cable: Four-pair, balanced twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500 MHz.

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. 3M.
2. AMP NETCONNECT; a TE Connectivity Ltd. company.
3. Belden Inc.
4. Berk-Tek, a Leviton Company.
5. CommScope, Inc.
6. General Cable; Prysmian Group North America.
7. Genesis Cable Products; Honeywell International, Inc.
8. Hitachi Cable America Inc.
9. Mohawk; a division of Belden Networking, Inc.
10. Prysmian Cables and Systems; Prysmian Group North America.
11. Superior Essex Inc.; subsidiary of LS Corp.

C. Standard: Comply with TIA-568-C.2 for Category 6a cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

1. Lead Content: Less than 300 parts per million.

E. Shielding/Screening: Unshielded twisted pairs (UTP) .

F. Cable Rating: Plenum.

G. Jacket: Blue thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

A. Twisted Pair Cable Hardware: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

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. 3M.
2. AMP NETCONNECT; a TE Connectivity Ltd. company.
3. American Technology Systems Industries, Inc.
4. Belden Inc.
5. Berk-Tek, a Leviton Company.
6. CommScope, Inc.
7. Dynacom Corporation.
8. General Cable; Prysmian Group North America.
9. Genesis Cable Products; Honeywell International, Inc.
10. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
11. Leviton Manufacturing Co., Inc.
12. Mohawk; a division of Belden Networking, Inc.
13. Molex Premise Networks.
14. Panduit Corp.
15. Prysmian Cables and Systems; Prysmian Group North America.
16. Siemon Co. (The).
17. Superior Essex Inc.; subsidiary of LS Corp.

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6a.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.

E. Connecting Blocks:

1. 110-style IDC for Category 6a.
2. Provide blocks for the number of cables terminated on the block, plus 30 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. Features:

a. Universal T568A and T568B wiring labels.
b. Labeling areas adjacent to conductors.
c. Replaceable connectors.
d. 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
3. Number of Jacks per Field: One for each four-pair cable indicated.

H. Patch Cords: Factory-made, four-pair cables in 48-inch (1200-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.

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 cover plate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

K. Cover Plate:

1. Four port, vertical single gang cover plates designed to mount to single gang wall boxes.
2. Plastic Cover Plate: High-impact plastic. Coordinate color with Section 260533.16 "Boxes and Covers for Electrical Systems."
3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

L. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

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. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA-568-C.1.

C. Factory test twisted pair cables according to TIA-568-C.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Routing:

1. Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

    a. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

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. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."

B. Comply with Section 260533.13 "Conduits for Electrical Systems."

C. Comply with Section 260529 "Hangers and Supports for Electrical Systems."

D. Comply with Section 260536 "Cable Trays for Electrical Systems."

E. Drawings indicate general arrangement of pathways and fittings.

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 dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment 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 telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Group connecting hardware for cables into separate logical fields.

E. 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 TIA-569-D, Annex A, "Firestopping."

B. Comply with "Firestopping Systems" Article in BISCI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

C. Comply with TIA-607-B and NECA/BICSI-607.

D. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 6 AWG grounding electrode conductor.

E. 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.

B. 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. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

C. 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. Nonconforming Work:

1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. Collect, assemble, and submit test and inspection reports.

E. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

END OF SECTION

SECTION 281000 - ACCESS CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Access control system requirements.

B. Access control units and software.

C. Access control point peripherals, including readers and keypads.

D. Accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other installers to provide suitable door hardware as required for both access control functionality and code compliance.
2. Coordinate the placement of readers with millwork, furniture, equipment, etc. installed under other sections or by others.
3. Coordinate the work with other installers to provide power for equipment at required locations.

B. Preinstallation Meetings:

1. Conduct meeting with facility representative to review reader and equipment locations.
2. Conduct meeting with facility representative and other related equipment manufacturers to discuss access control system interface requirements.

C. Federal Identity, Credential, and Access Management (FICAM) Compliance

1. All infrastructure provided shall provide FICAM compliance in this building at the appropriate Assurance Level. Provide all components, readers, software, licensing, etc. as required for FICAM compliance.

1.3 SUBMITTALS

A. See Section 013300 Submittal Procedures.

B. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include elevations and details of proposed equipment arrangements. Include system interconnection schematic diagrams. Include requirements for interface with other systems.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.

D. Certify that proposed system design and components meet or exceed specified requirements.

E. Certificates of on-site factory trained/certified technician for software and hardware.

F. Certificate of on-site Certified Systems Engineer (CSEIP) for Identity, Credential, and Access Management (ICAM) Physical Access Control System (PACS).

G. Manufacturer's detailed field-testing procedures.

H. Field quality control test reports.

I. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.

J. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1.4 QUALITY ASSURANCE

A. Comply with the following:

1. NFPA 70.
2. The requirements of the local authorities having jurisdiction.
3. Applicable TIA/EIA standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.6 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.7 WARRANTY

A. See Section 017700 Closeout Procedures for additional warranty requirements.

B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 ACCESS CONTROL SYSTEM REQUIREMENTS

A. Provide new access control system consisting of required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Access Control System shall be compatible with AMAG Symmetry Access Control Professional Homeland Security v9.4 or higher centralized software located on NIFC server.

C. Surge Protection:

1. Provide surge protection for readers and door strikes/locks.
2. Provide equipment power surge protection where electrical distribution system surge protection is not provided.

D. Interface with Other Systems:

1. Provide products compatible with existing access control system and other systems requiring interface with access control system.

E. Assurance Level: Meet the General Services Administration (GSA) Federal Information Processing Standard (FIPS) Publication 201, Evaluation Program Functional Requirements and Test Cases (FRTC) 1.3, for the levels indicated. Provide products listed under FIPS Approved Product List (APL) compatible with existing campus.

1. Single Factor PACS: Non-FICAM one factor authentication without PAM: Contactless PIV proximity car read, with the option to enter a numeric code to perform door unlock/lock commands.
2. Dual Factor PACS: FICAM Assurance Level 2: Two factor authentication with PAM: Contact PIV card insertion and input PIN.

F. Provide products listed, classified, and labeled as suitable for the purpose intended.

1. Access Control Units and Readers: Listed and labeled as complying with UL 294.

2.2 ACCESS CONTROL UNITS AND SOFTWARE

A. Provide access control units and software compatible with campus system, and new readers to be connected.

B. Access Control Unit Hardware:

1. Control Unit: AMAG Technology Model M4000-DEC4

2. Network Board: AMAG Technology Model M4000-DBB
3. Lockable Enclosure: AMAG Technology Model M4000-CAB2A, M4000-CAB2, or equivalent, sized to optimize placement of all access control unit hardware. Include power supply.
4. Board Fixing Kit
5. Adapter Mount Plate
6. pivCLASS Authentication Module (PAM): AMAG Technology Model PVC-PAM-B
7. Input/Output board as required.

C. Access Control Software and Licensing:

1. Software: AMAG Technology PRO-PLAT-V9.4-HSE
2. Licensing: AMAG Technology PRO-LIC-008-V9
3. Data Connect Module: AMAG Technology DATA-CONNECT-V9

D. Hardware Credential Enrollment

1. AMAG Technology No. 799-105100
2. AMAG Technology No. R31210349-1

2.3 ACCESS CONTROL POINT PERIPHERALS

A. Provide devices compatible with control units and software.

B. Provide devices suitable for operation under the service conditions at the installed location.

C. Card Readers:

1. Input: Lighted numeric keypad.
2. Output: LED light and integrated buzzer providing an indication of card read and lock/unlock status.
3. Models: Provided and programmed to meet Assurance Level indicated, and listed on FIPS Approved Products List.

D. Door Position Switches:

1. Magnetic Contacts: Encapsulated reed switch(es) and separate magnet; designed to monitor opened/closed position of doors.
2. Contact Color: To be selected by Government from manufacturer's available standard colors.

E. Request to Exit Devices:

1. Door Hardware with Integral Request to Exit Switches: Comply with Section 087111.

F. Door Locking Devices (Electric Strikes and Magnetic Locks): Comply with Section 087111.

G. Battery Backup:

1. Input: 120V AC, 3.5 Amps, overcurrent protection with automatic reset.
2. Output: 12V or 24V, 8 channels, 6 Amps total, overcurrent protection with automatic reset.
3. Power Supply
4. Batteries: 12V AGM sized to provide a minimum of one hour of static operation of the access control system, 5 year design life, UL94 HB listed case.

2.4 ACCESSORIES

A. Provide components as indicated or as required for connection of access control system to devices and other systems indicated.

B. Unless otherwise indicated, credentials to be provided by Contractor.

1. Provide credentials compatible with readers and control units/software to be used.

C. Unless otherwise indicated, network switches required for network connections to system components to be provided by Contractor.

D. Provide cables as indicated or as required for connections between system components.

1. Data Cables for IP Network Connections: Cat 6 unshielded twisted pair (UTP).
2. RS-485 Cables: FICAM compliant for access system, 6-conductor twisted-pair, wire gauge as determined by manufacturer for cable length and card reader, Over-All-Shield, grounded drain wire.

E. Provide end-of-line resistors (EOLR) as required for supervision of hardwired connections.

F. Provide accessory racks/cabinets as indicated or as required for equipment mounting.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to system.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install access control system in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Wiring Method: Unless otherwise indicated, use cables (not in conduit).

1. Use suitable listed cables in wet locations, including underground raceways.
2. Use suitable listed cables for vertical riser applications.
3. Use listed plenum rated cables in spaces used for environmental air.
4. Install wiring in conduit for the following:

    a. Where required for rough-in.
    b. Where required by authorities having jurisdiction.
    c. Where exposed to damage.
    d. Where installed outside the building.
    e. For exposed connections from outlet boxes to devices.

5. Conduit: Comply with Section 260533.13.
6. Conceal cables unless specifically indicated to be exposed.
7. Use power transfer hinges complying concealed connections to door hardware.
8. Route exposed cables parallel or perpendicular to building structural members and surfaces.
9. Do not exceed manufacturer's recommended maximum cable length between components.

D. Provide grounding and bonding in accordance with Section 260526 and with manufacturer requirements.

E. Install firestopping to preserve fire resistance rating of partitions and other elements.

F. Identify system wiring and components in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

C. Prepare and start system in accordance with manufacturer's instructions.

D. Program system parameters according to requirements of Government.

E. Test for proper interface with other systems.

F. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

A. See Section 017700 Closeout Procedures for closeout submittals.

B. Demonstration: Demonstrate proper operation of system to Government, and correct deficiencies or make adjustments as directed.

C. Training: Train Government's personnel on operation, adjustment, and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Instructor: Manufacturer's authorized representative.
3. Location: At project site.

3.6 PROTECTION

A. Protect installed system components from subsequent construction operations.

END OF SECTION

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SECTION 283100 – 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 01 Specification Sections, apply to this Section.

1. Expand and modify the existing fire alarm system to accommodate remodel work as indicated on contract drawings.

1.2 SUMMARY

A. Section Includes:

1. Existing fire-alarm system to be modified.
2. Addressable fire-alarm system.
3. Fire-alarm control unit (FACU).
4. Manual fire-alarm boxes.
5. System smoke detectors.
6. Fire-alarm notification appliances.
7. Fire-alarm remote annunciators.
8. Fire-alarm addressable interface devices.
9. Digital alarm communicator transmitters (DACTs).

1.3 DEFINITIONS

A. DACT: Digital alarm communicator transmitter.

B. EMT: Electrical metallic tubing.

C. FACU: Fire-alarm control unit.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

F. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.

2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.4 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. When new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.5 ACTION SUBMITTALS

A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Contracting Officer.

B. Submittals shall be complete and include all information required in parts D and E below. Partial submittals will not be reviewed and automatically stamped “REVISE & RESUBMIT” and returned to the contractor.

C. Submittals provided in digital (.pdf) format will be acceptable.

1. Digital file names shall include project name and revision number and in the following format: [PROJECTNAME]_FIRE ALARM SUBMITTAL_R[0].pdf

D. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.
3. Model-specific information shall be highlighted for clarity on documents encompassing multiple types of devices.

E. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in "Documentation" section of NFPA 72 for Shop Drawings (Installation Documentation).
2. Include plans, elevations, sections, and details, including details of attachments to other Work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Annunciator panel details as required by authorities having jurisdiction.
5. Detail assembly and support requirements.

6. Include voltage drop calculations for notification-appliance circuits.
7. Include wire routing of all notification-appliance circuits including the locations of all end-of-line devices.
8. Include battery-size calculations and battery sizes being provided.
9. Include input/output matrix.
10. Include performance parameters and installation details for each detector.
11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within airflow range of air-sampling detector.
13. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
    c. Locate detectors in accordance with manufacturer's written instructions.
    d. Show air-sampling detector pipe routing.

14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

F. Re-submittals

1. Submittals returned and requiring revisions or corrections shall be re-submitted in their entirety with all revisions applied and highlighted. Partial submittal documents will be rejected.

1.6 INFORMATIONAL SUBMITTALS

A. Certificates (copies of):

1. Contractors license as required by the state project is located in.
2. Manufacturer’s certification of installing personnel for equipment supplied.
3. NICET Certification (Fire Alarm Systems) of installing technicians.

B. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in other sections, include the following:

    a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
g. Record copy of site-specific software.
h. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

    1) Equipment tested.
    2) Frequency of testing of installed components.
    3) Frequency of inspection of installed components.
    4) Requirements and recommendations related to results of maintenance.
    5) Manufacturer's user training manuals.

i. Manufacturer's required maintenance related to system warranty requirements.
j. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
2. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
3. Keys and Tools: One extra set for access to locked or tamper-proofed components.
4. Audible and Visual Notification Appliances: One of each type installed.
5. Filters for Air-Sampling Detectors: Two of each type installed, but no fewer than one unit of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:

1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
2. Installation must be by personnel certified by NICET as fire-alarm Level II (minimum) technician.
3. Obtain certification by NRTL in accordance with NFPA 72.
4. Licensed or certified by authorities having jurisdiction.

1.10 FIELD CONDITIONS

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXISTING FIRE-ALARM SYSTEM TO BE MODIFIED

A. Description: Existing system was in the process of installation at the time of design. Contractor shall field verify existing make and manufacture prior to bidding project.

B. Source Limitations for Fire-Alarm System and Components: Components must be compatible with, and operate as extension of, existing system. Provide system manufacturer's certification that components provided have been tested as, and will operate as, a system.

2.2 ADDRESSABLE FIRE-ALARM SYSTEM

A. Acceptable manufacturers:

1. Matching existing system manufacture.

B. Performance Criteria:

1. Regulatory Requirements:

a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

2. General Characteristics:

a. Automatic sensitivity control of certain smoke detectors.
b. Fire-alarm signal initiation must be by one or more of the following devices:

1) Manual stations.
2) Heat detectors.
3) Smoke detectors.
4) Automatic sprinkler system water flow.

c. Fire-alarm signal must initiate the following actions:

1) Continuously operate alarm notification appliances.
2) Identify alarm and specific initiating device at FACU and remote annunciators.
3) Transmit alarm signal to remote alarm receiving station.
4) Unlock electric door locks in designated egress paths.
5) Release fire and smoke doors held open by magnetic door holders.
6) Switch HVAC equipment controls to fire-alarm mode.
7) Close smoke dampers in air ducts of designated air-conditioning duct systems.
8) Record events in system memory.

d. Supervisory signal initiation must be by one or more of the following devices and actions:

1) Valve supervisory switch.
2) Zones or individual devices have been disabled.
3) Duct smoke detection associated with HVAC system.

e. System trouble signal initiation must be by one or more of the following devices and actions:

1) Open circuits, shorts, and grounds in designated circuits.
2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4) Loss of primary power at FACU.
5) Ground or single break in internal circuits of FACU.
6) Abnormal ac voltage at FACU.
7) Break in standby battery circuitry.
8) Failure of battery charging.
9) Abnormal position of switch at FACU or annunciator.

f. System Supervisory Signal Actions:

1) Initiate notification appliances.
2) Identify specific device initiating event at FACU and remote annunciators.

3) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
4) Transmit system status to building management system.
5) Display system status on remote annunciator.

g. Network Communications:

1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.

h. Device Guards:

1) Description: Welded wire mesh of size and shape for manual station, smoke detector, gong, or other device requiring protection.

a) Factory fabricated and furnished by device manufacturer.
b) Finish: Paint of color to match protected device.

2.3 FIRE-ALARM CONTROL UNIT (FACU)

1. Existing to remain. (Silent Knight Model 6808)

2.4 MANUAL FIRE-ALARM BOXES

1. Existing to remain.

2.5 SYSTEM SMOKE DETECTORS

A. Photoelectric Smoke Detectors:

1. Match existing make and manufacture.

2.6 FIRE-ALARM NOTIFICATION APPLIANCES

1. Match existing make and manufacture.

B. Fire-Alarm Visible Notification Appliances:

1. Match existing make and manufacture.

2.7 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

A. Compatible with and listed for use with existing FACU.

2.8 FIRE ALARM COMMUNICATOR

a. Existing to remain.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary guard service in accordance with requirements indicated:

1. Notify Construction Manager and/or Government 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 Construction Manager's and Government's written permission.

C. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 INSTALLATION OF EQUIPMENT

A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before other trades have completed cleanup must be replaced.
2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of building.
2. Connect new equipment to existing monitoring equipment at supervising station.
3. Expand, modify, and supplement existing control and monitoring equipment as necessary to extend existing control and monitoring functions to new points. New components must be capable of merging with existing configuration without degrading performance of either system.

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.

D. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.

E. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

F. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.

G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.

H. Device Location-Indicating Lights: Locate in accessible space, easily viewed from floor level near device they monitor.

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Division 26 requirements.

B. Ground equipment in accordance with Division 26 requirements.

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Division 26 requirements.

C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

A. Pathways above recessed ceilings and in accessible locations may be routed exposed.

1. Exposed pathways located less than 96 inch above floor must be installed in EMT.

B. Pathways in inaccessible space (above gypsum ceilings and within walls) must be installed in EMT.

C. Exposed EMT must be painted red enamel.

3.7 CONNECTIONS

A. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Smoke dampers in air ducts of designated HVAC duct systems.
4. Magnetically held-open doors.
5. Electronically locked doors and access gates.
6. Alarm-initiating connection to activate emergency lighting control.
7. Supervisory connections at valve supervisory switches.

3.8 GROUNDING

A. Ground FACU and associated circuits in accordance with Division 26 requirements.

B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.9 FIELD QUALITY CONTROL

A. Field tests must be witnessed by authorities having jurisdiction.

B. Administrant for Tests and Inspections:

1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.

2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.10 DEMONSTRATION

A. Train Government's maintenance personnel to adjust, operate, and maintain fire-alarm system. Allow Government to record training.

3.11 MAINTENANCE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.12 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Government to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 283100